POWER TOPICS CROSS-INDEX

STEAM GENERATION
POWER GENERATION
WATER POWER
DIESEL & GAS ENGINES
AIR CONDITIONING & HEATING
REFRIGERATION
PUMPS & COMPRESSORS
STEAM SERVICES
ELECTRICITY & ELEVATORS
INSTRUMENTS & CONTROL
PIPING SYSTEMS
MECHANICAL TRANSMISSION
POWER MISCELLANY

VOLUME 83 NUMBER 12

POWER

N. O. WYNKOOP, *Publisher* — PHILIP W. SWAIN, *Editor*

Associate Editors F. A. ANNETT, S. A. TUCKER — E. J. TANGERMAN, *Consulting Editor* — *Assistant Editors* B. E. SAWYER, L. N. ROWLEY

PAUL WOOTON, *Washington* G. C. TENNEY, *San Francisco* H. S. KNOWLTON, *Boston*

DECEMBER, 1939

Conn. College for Women installs steam-diesel combination 57

Letters from a turbine specialist—No. 4, on overloads 59

Hospital power-service set-ups need an engineering doctor 60

Why combustion gas turbines—developments and tests 62

Worm-gear units save space for draft-fan drives 65

How about low-fusion coal?—typical case worked out 66

How to use pH in industrial processes and power field 68

Process sets the power pattern at Front Royal, Va. 70

Low head produces high capacity for Vargon hydro plant 74

Pumps, like people, change actions to suit conditions 77

Special section—12 pages on modern "super" boilers 79

Photostory on Eagle Mountain Station, Colorado aqueduct 91

Tropical Ice Gardens, Los Angeles, refrigerating plant 94

THE OPERATING ENGINEER

No One Complains 95 — We Need Apprentices 97

Repairing Piston Head 98 — Don't Blow Dust Around 99

Practical Aids 100 — Readers' Problems 104

Argument Corner 108 — Questions and Answers 109

How to make and use a water level for power machinery 110

OTHER DEPARTMENTS

Census questionnaire to be filed out by all power plants 112

Engineers' Bookshelf 114 — Data Sheet No. 89 122

Power Lines 124 — George Edwards 130

Publication office: 99-129 North Broadway, Albany, N. Y.
Editorial & Executive Offices: 330 West 42nd St., New York, N. Y.

A McGRAW-HILL PUBLICATION

JAMES H. MCGRAW, Founder and Honorary Chairman

JAMES H. MCGRAW, JR., President — HOWARD EHRLICH, Executive Vice-President — MASON BRITTON, Vice-Chairman

B. R. PUTNAM, Treasurer — D. C. MCGRAW, Secretary — J. E. BLACKBURN, JR., Director of Circulation

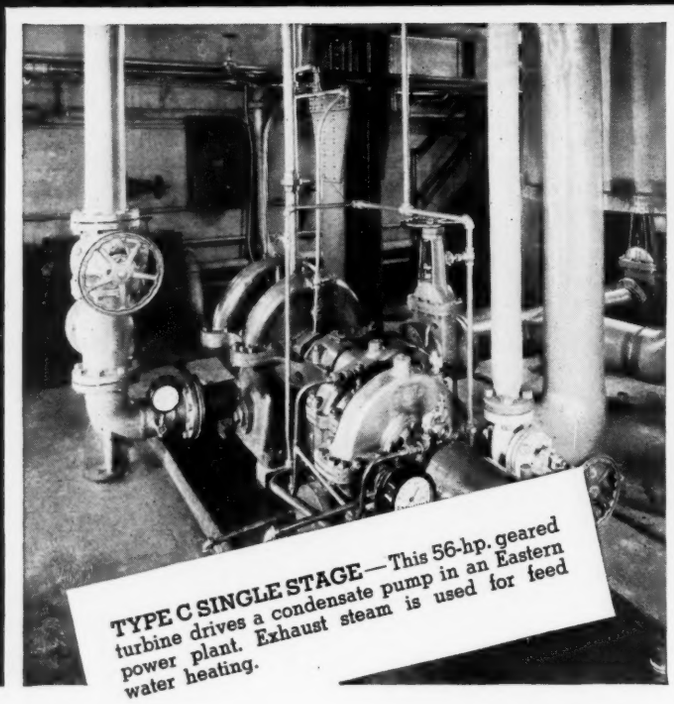
CHICAGO, 520 North Michigan Ave.
SAN FRANCISCO, 68 Post St
WASHINGTON, National Press Bldg.
PHILADELPHIA, 16 South Broad St.
CLEVELAND, 1510 Hanna Bldg.
DETROIT, 2-144 General Motors Bldg.
ST. LOUIS, 455 Paul Brown Bldg.
BOSTON, 1427 Statler Bldg.
ATLANTA, 1105 Rhodes Haverty Bldg.
LONDON, Aldwych House, Aldwych, London, W C.2

Copyright, 1939, by McGraw-Hill Publishing Company, Inc.

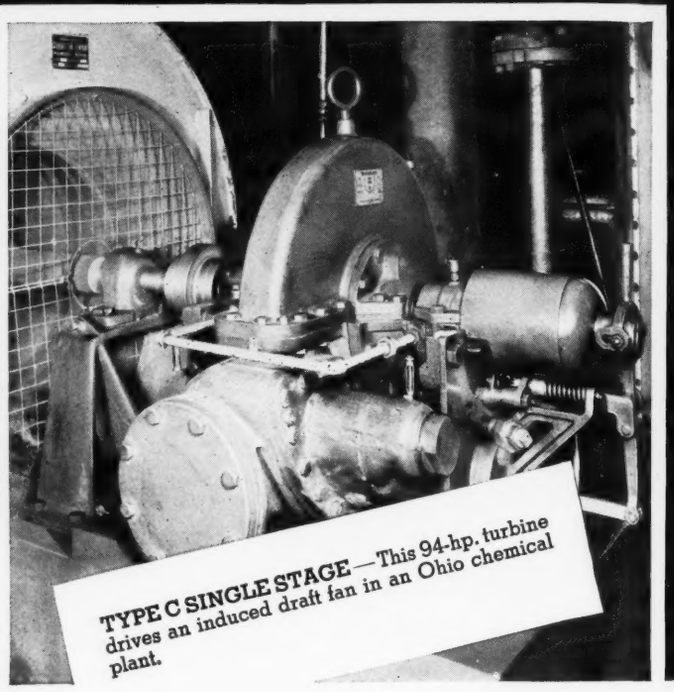
POWER articles are currently indexed in both the Industrial Arts and the Engineering Indexes, available at public libraries. Also every year POWER issues an annual index of its own. Cable Address: "McGraw-Hill, N. Y."

Steam Headquarters

PROOF OF STEAM



TYPE C SINGLE STAGE—This 56-hp. geared turbine drives a condensate pump in an Eastern power plant. Exhaust steam is used for feed water heating.



TYPE C SINGLE STAGE—This 94-hp. turbine drives an induced draft fan in an Ohio chemical plant.

THESE JOBS ARE NOW BEING DONE WELL BY WESTINGHOUSE TURBINES

PUMP DRIVES

Boiler Feed, Oil Refinery Pumps, Water Pumps, Fire Pumps, Chemical Pumps.

•

FAN DRIVES

Induced and Forced-Draft Fans, Ventilating Fans, Blowers and Gas Boosters.

•

COMPRESSOR DRIVES

Air and Refrigeration Compressors of all types.

•

OTHER MECHANICAL DRIVES

For operating Paper Machines, Cellophane Machines, Pulverizers, Line Shafts, Jordans.

•

GENERATOR DRIVES

For operating Electrical Generators, alternating and direct current.

There are hundreds of steam drive installations by Westinghouse in United States — some of them near enough to you for convenient inspection. Among these you will probably find a "working model" of the turbine that will meet your conditions most effectively and most economically.

Westinghouse experience is so broad, and applications cover so wide a range, that we seldom find difficulty in selecting the most effective and economical steam drive, even when conditions present entirely new problems.

BUY RESULTS . . . LEAVE TURBINE DETAILS TO STEAM HEADQUARTERS

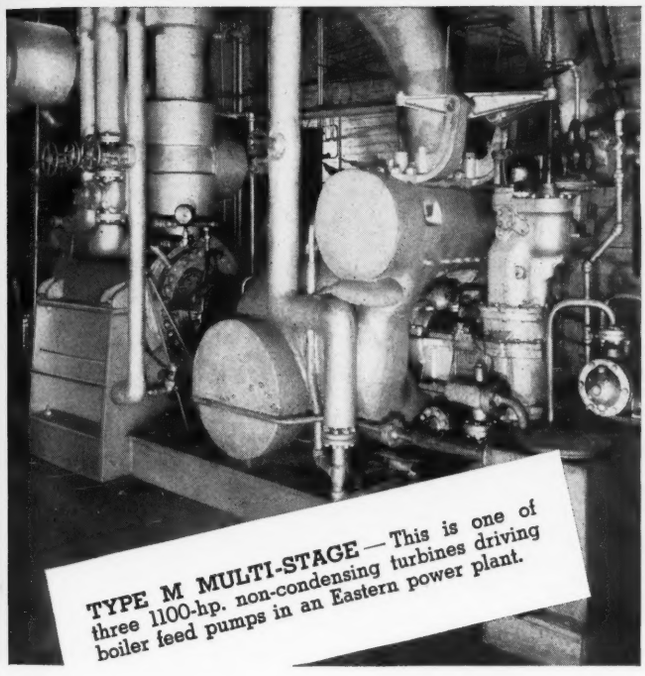
In selecting a steam drive for any purpose, there is one question that suggests the answer to all others — "Will it do your job precisely the way you want it done?" Details of design and construction are important only as they help to find a satisfactory answer to this question.

That is why so many careful buyers have learned to leave the details to Steam Headquarters. They recognize

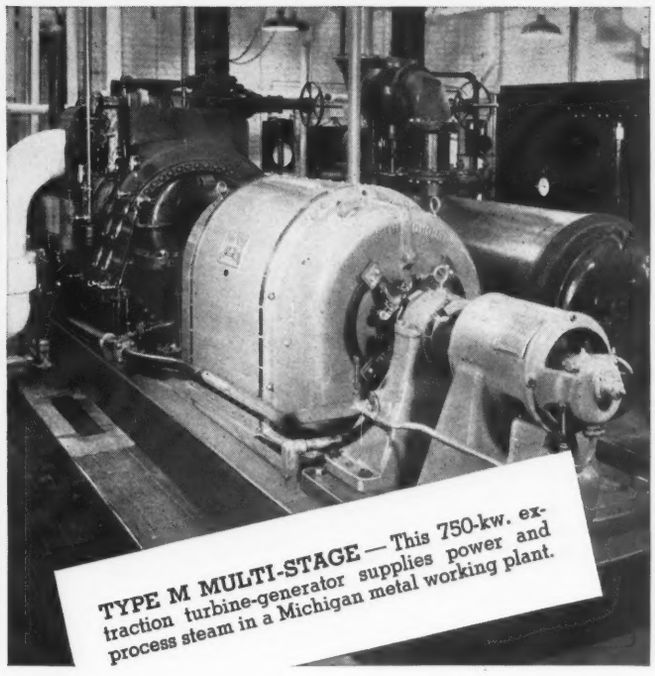
Westinghouse *Complete*

brings you . .

DRIVE RESULTS!



TYPE M MULTI-STAGE — This is one of three 1100-hp. non-condensing turbines driving boiler feed pumps in an Eastern power plant.



TYPE M MULTI-STAGE — This 750-kw. extraction turbine-generator supplies power and process steam in a Michigan metal working plant.

the place of the specialist — the value of a reservoir of experience — and they buy RESULTS.

STEAM HEADQUARTERS SERVICE COVERS EQUIPMENT . . . ENGINEERING . . . MAINTENANCE

There is a complete line of turbines, from 5 hp. up, with all needed steam auxiliaries. There is competent engineering experience, to help you select the best equipment for your purpose. And there is a maintenance service, accessible through convenient points, to keep your steam equipment up to par.

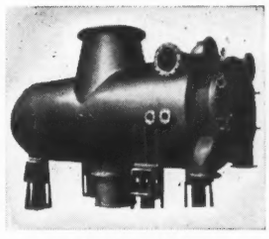
No place can you find more complete facilities for designing, building and installing steam drives for all industries.

CONSULT STEAM HEADQUARTERS

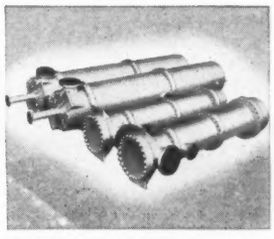
There is no obligation involved when you draw upon the experience of Steam Headquarters. We can save you time and worry in the selection of your steam drive. Address any Westinghouse Sales Office.

J-50204

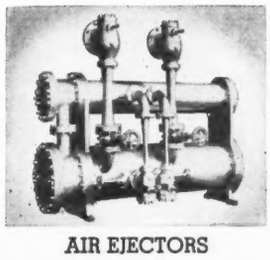
WESTINGHOUSE MAKES A COMPLETE LINE OF STEAM AUXILIARIES



CONDENSERS



FEED WATER HEATERS



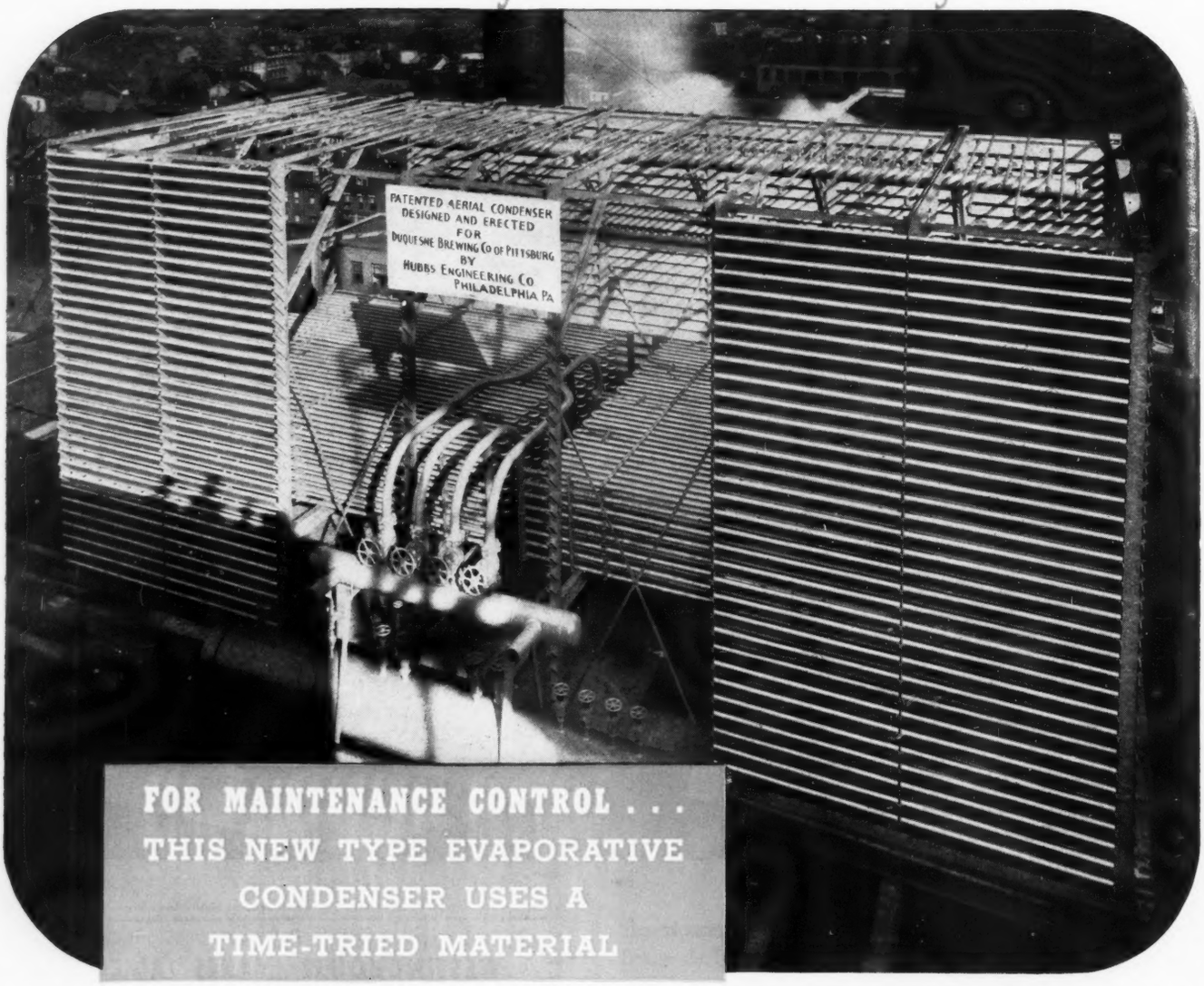
AIR EJECTORS

STOKERS

Steam Service

WESTINGHOUSE ELECTRIC

Corrosion costs you more than Wrought Iron



BYERS WROUGHT IRON

Maintenance engineers concerned with condenser problems may find a helpful suggestion here. This new aerial condenser, combining the functions of a cooling tower and condenser, was built for Duquesne Brewing Company, Pittsburgh, Pa., by the Hubbs Engineering Company of Philadelphia. Byers extra heavy wrought iron pipe was bent to form individual coils without the use of welded return bends, and sections were assembled by field welds. Connections near center of photo were bent from 4" Byers Wrought Iron pipe. Byers Wrought Iron sheet and plate were used for louvres and pan.

In using Byers Wrought Iron, the company followed the practice of all engineers who "go by the record." A study of comparative service life of 32 condensers, 16 of which were wrought iron, showed that wrought iron lasted—on the average—2⅜ times as long.

Condenser piping is only one of the many corrosive services where wrought iron has definitely proven its greater durability and economy. Your plant undoubtedly has many services where corrosion costs you more than wrought iron. If you will write, giving details, our Engineering Service Department will (1) Determine the probable corrosive conditions; (2) Relate them to similar conditions encountered elsewhere and recorded in our files; (3) Interpret the results in terms of 75 years' experience with corrosion problems; and (4) Make recommendations . . . supported by service records. Ask for a complimentary copy of our bulletin, "Wrought Iron in Refrigeration and Air Conditioning Systems."

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

BYERS GENUINE WROUGHT IRON

TUBULAR AND FLAT ROLLED PRODUCTS

Specify Byers Genuine Wrought Iron Pipe for corrosive services and Byers Steel Pipe for your other requirements

POWER

Established 1882 PHILIP W SWAIN, Editor

First Job for 1940

Many thousands of POWER readers have a job ahead for early 1940—filling out the tabulation shown on page 112.

Like death and taxes, it can't be avoided. Starting January 2, an army of 12,000 enumerators will visit every manufacturing establishment in the United States. They will come armed with schedule blanks for the 1939 Census of Manufactures and—more important—with government authority to demand answers to all listed questions, including "Inquiry 6" (Power Equipment) and "Inquiry 7" (Fuel and Energy Used).

We assume that the enumerator will present himself to one of the company executives. But in the normal course of events that executive must immediately turn to his power engineer for the correct answers to the questions on prime movers, fuels and electrical energy.

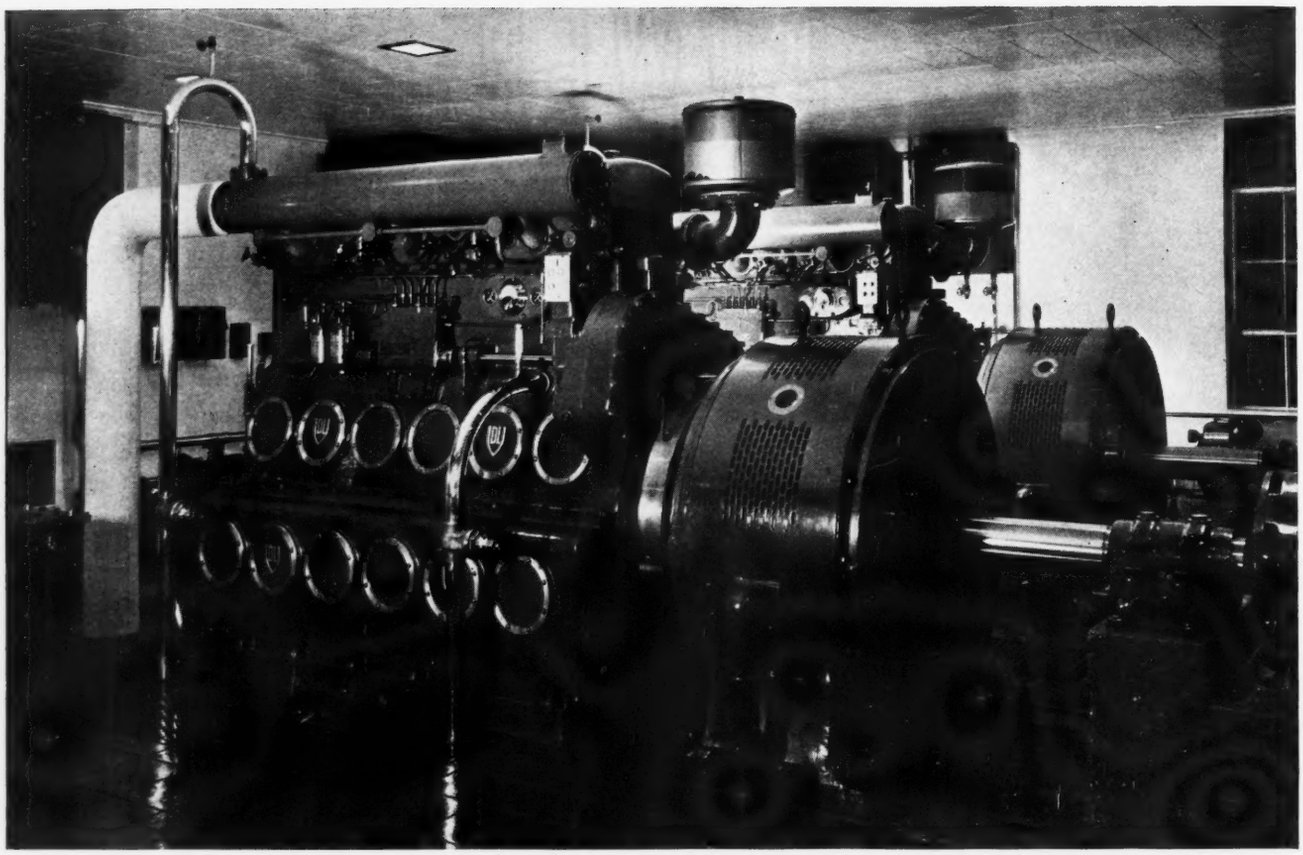
The engineer will then have to list the number, horsepower and kilowatt ratings of his steam turbines, diesels, other internal-combustion engines, hydro-turbines and waterwheels. He will have to list separately the power equipment that is ordinarily idle, but held for standby (not junk). He will have to tabulate the 1939 consumption and cost of his bituminous coal, anthracite coal, coke, fuel oil, natural gas, manufactured gas, mixed gas. He must record the electrical energy generated locally, the amount sold by his plant and the amount purchased.

We are not writing this editorial to urge you to assemble this information. We know you will have to do that anyway, regardless of what we may say. We are merely telling the reader what's ahead so he can (if he wishes) assemble the data immediately after January 1 and be sitting pretty when the day of judgment arrives—that, when the Census enumerator calls.

So much for finishing a job that's got to be done, willy nilly. Now let's say a word from the broader angle. This is the first time since 1929 that the Census of Manufactures has included really comprehensive data on fuel and power. It will answer questions now in the mind of every live power man. What's been happening to industrial steam engines, steam turbines, diesels, and so on, in this ten-year period. What's happening to the amount of power generated by industry, and bought by industry from central supply? How much power is sold by industrials? Is industry burning more oil and gas than in 1929 and how much more? How about coal consumption?

The government has 12,000 men to gather the answers from you and for you. It has the power to demand complete returns. It has the money to tabulate the results by industries, by states, counties, and cities. The little annoyance it is going to cause you and your boss will be returned many fold in a wealth of useful information. We urge all POWER readers to cooperate to the limit —to assemble the desired information promptly, cheerfully, *accurately*.

This is one questionnaire that can not and should not be avoided.



Diesels bring economy into the picture by handling peaks and summer loads at high efficiency

Diesels Go to College

Combined with backpressure turbines, they strike a balance between heat and power loads to produce maximum economy in Connecticut College's new, hurricane-born power plant

A LITTLE MORE than a year ago, Connecticut College's power plant was a shambles of fallen brick and twisted steel. New England's never-to-be-forgotten hurricane roared down the Thames River valley, cracked the tall brick stack like a toothpick and brought it crashing down on the boilers. For ten days the engineering staff struggled to maintain essential services in an area that was completely stricken. Now after a year of intensive construction activity, they are settling down to operate a modern small steam-diesel plant, a model of simple yet sound design.

To get the picture straight, let's go back a few years. One of the newer colleges for women, Connecticut College, founded and endowed in 1911, stands on a hillside overlooking the Thames River, just outside of New London. Providing a broad cultural education as well as training for many of the occupations now open to women, the college has had a rapid growth. However, the present enrollment of 750 probably represents a maximum for a time. Growth in student body meant a need for new facilities, and four new buildings have just been completed—an auditorium, a chapel, a hall for science and fine arts, and a cooperative dormitory.

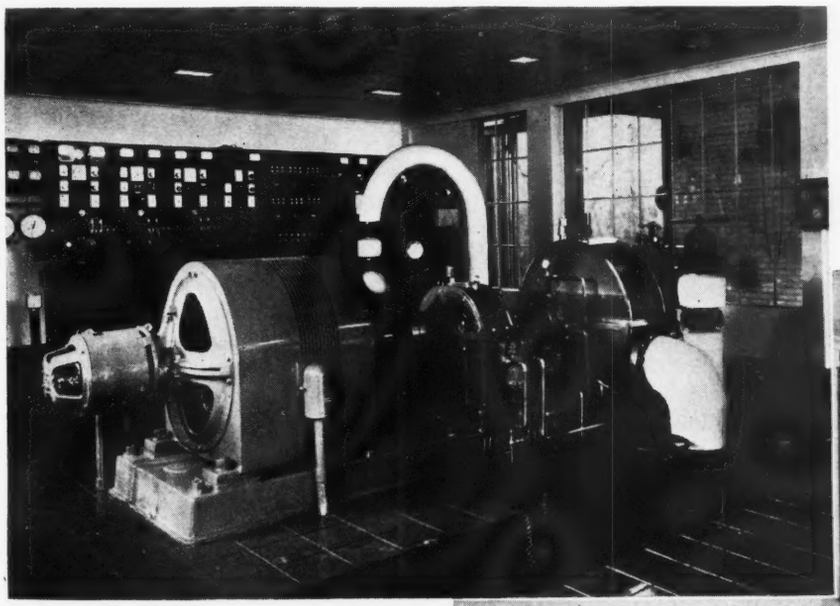
Modernization Plans

With these expansion plans under way, consideration was given, about two years ago, to modernization of the power plant, which then consisted of two 1500-sq-ft stoker-fired boilers supplying steam for heating, hot water, and cooking. All power was purchased. As a first step in the projected revamping, the old boilers were torn out and three new 2580-sq-ft, 3-drum bent-tube Bigelow units, with refractory furnaces, were installed. Single-retort underfeed stokers, with side dumps (Combustion Engineering Type E) fire these boilers. A 63-kva, 0.8-pf, 3970-rpm, De Laval backpressure turbine, geared to a 1200-rpm Crocker-Wheeler generator, had been previously installed as standby in the event of power failure. This unit was large enough to maintain powerhouse services, to keep essential water pumps going and to supply a few emergency lighting circuits.

There must have been a touch of prophecy in the purchase of the turbine, for when the hurricane struck, the turbine proved worth its weight in gold. That night, the college, like most of the rest of New England, staggered along without power services. But in 40 hours

the college engineering staff, working like Trojans under lights fed from the small turbine-generator supplied from a steam shovel used in campus construction work, had patched up the one boiler not completely wrecked and had rigged a temporary steel stack rushed from New Haven. By Friday morning, after 40 hours of sleepless activity, the college had power for necessary services.

It was not until ten days later that full utility service was restored, and the entire incident dramatized the previously-recognized need for a private power plant, with ample standby capacity. Another turbine, already on order, was promptly installed and purchase of two diesel generating sets, to serve as standby and to balance heat and power loads, was authorized. Re-



This main turbine takes load as steam demand permits; smaller unit between main machine and switchboard serves as standby

building of the boilers demolished by the storm went right ahead, as did construction of a new 125-ft radial brick stack. By February, both diesels were in service and on March 1, utility service was discontinued. Since then activity has centered around provision of accessories, numerous operating improvements, and finishing of the power house interior.

Nestled into the side of a hill and surrounded by trees and shrubs, as a POWER editor saw it a month ago, there is no longer the slightest sign of the hurricane's destruction; the plant presents an exceptionally attractive picture, inside and out. This is the net result of several factors: sound engineering and layout, careful attention to architectural detail, and topnotch maintenance and housekeeping.

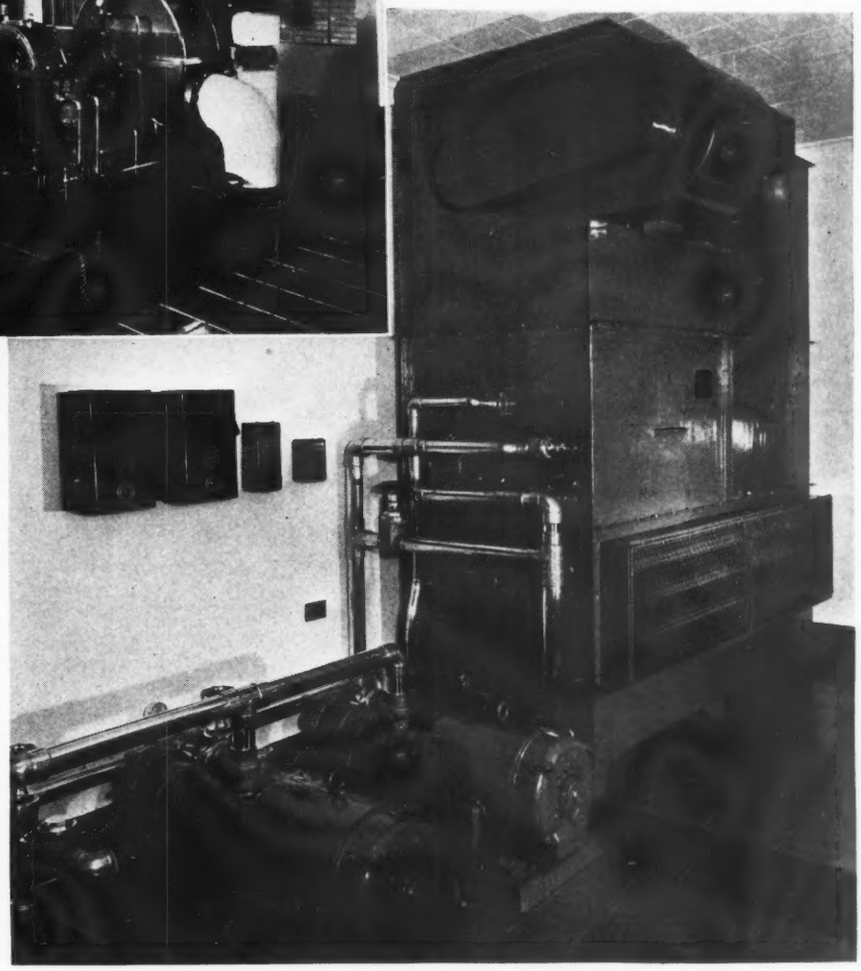
The boiler room is on the north side of the building, down the slope so that the wall from floor to roof is in the clear. On the south side the building has two stories, with the engine-room on the ground floor (semi-basement because of the slope of the hill) and the machine shop and Chief Engineer's office above. Concrete coal storage is provided on the west side of the boiler house, cut into the hillside in such a way that trucks can drive in over the storage space and dump into it through ground-level openings.

The remainder of the coal-handling system is equally simple and convenient. Chutes lead from the storage space to the basement level, filling a small car which is rolled under an opening in the boiler-room floor and hoisted into position over the stoker hopper by way of an electric monorail hoist. The fireman cleans the ash pits when necessary and loads ash into the same car, using the hoist to carry it to the door at the end of the firing aisle, where it can be unloaded directly into a truck.

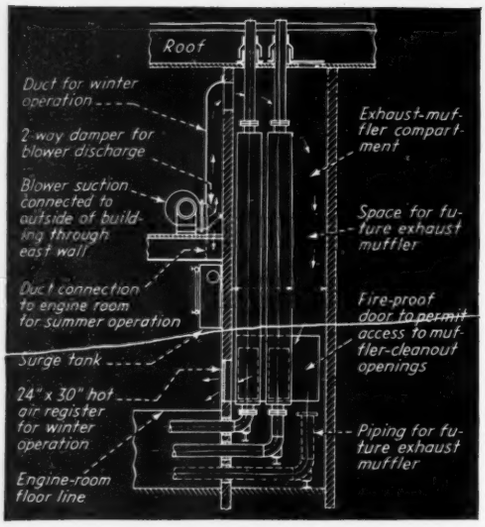
Boilers

The three boilers generate steam at 185 lb, saturated; there are no economizers or air heaters. A single panel mounts Bailey steam-flow air-flow meters and draft gages for forced-draft, uptake, and furnace pressure. The stokers are motor-driven, with integral fans. A Ruggles-Klingemann regulator controls the vortex dampers on the stoker fans in accordance with steam pressure. Constant-speed motors power the stokers and fans, and variations in fuel feed are obtained by a speed changer, which can be controlled either manually or automatically. An Engineer Co furnace-pressure regulator completes the combustion-control set-up.

The newest turbine, a 185-kva, 0.8-pf, 3240-rpm Whiton unit geared to a 1200-rpm Crocker-Wheeler generator, takes steam at close to boiler pressure



Evaporative unit cools jacket water from both engines; circulating pumps in foreground


Roof
Duct for winter operation
2-way damper for blower discharge
Blower suction connected to outside of building through east wall
Duct connection to engine room for summer operation
Surge tank
24" x 30" hot air register for winter operation
Engine-room floor line
Exhaust-muffler compartment
Space for future exhaust muffler
Fire-proof door to permit access to muffler-cleanout openings
Piping for future exhaust muffler

Placing exhaust mufflers in compartment, with fan and dampers, provides heat for engine room during winter months

and exhausts at 30-lb. Exhaust from this unit and the smaller De Laval (used as standby) feeds the distribution system, supplying the scattered college buildings, and also furnishes 30-lb steam for heating feedwater. First-stage heating takes place in a Cochrane deaerating heater; feed is pumped to the heater, from a large receiver, by Micro-Westco pumps, motor-driven. Two Davidson simplex steam pumps take their suction from the deaerating heater and pump to the second stage, a Whitlock Coil Pipe Co closed heater, from which the feed goes directly to the boilers, under control of Copes regulators. Exhaust from the steam-driven boiler-feed pumps supplies the deaerating heater.

Diesels

At the east end of the engine room stand the two 225-hp, 514-rpm, 6-cyl, 9x12-in. De La Vergne diesels, driving Crocker-Wheeler generators, with direct-connected exciters, rated at 156-kva, 0.8-pf (actual pf runs between 0.9 and 0.95, so all generator ratings are conservative). These engines stand on concrete foundations resting on hardpan and there is remarkably little vibration. An acoustic tile ceiling in the engine room reduces noise.

Fuel, stored in two 2250-gal. underground tanks, reaches the engines by way of 50-gal. day tanks. Two sets of Purolator filters, one set wall-mounted and the other carried on the engine frames, keep oil free from impurities. The engines are fitted with Bosch fuel pumps and Alnor exhaust pyrometers. Lube oil circulates through an oil cooler and the system includes a Briggs clarifier for maintaining oil at close to desired condition.

Intake air is drawn from the engine room, through Burgess filters. Exhaust pipes lead down under the floor and into a vertical compartment in which the Maxim silencers are mounted. A ventilating fan draws outside air through this stack and supplies heated air to the engine room for winter operation. The accompanying drawing shows how this is arranged.

The jacket-water cooling system follows the trend to use of evaporative coolers. A single Buffalo Forge cooler, standing in the northeast corner of the engine-room, holds jacket water of both engines down to around 120-130 F (into engine). The unit has sufficient capacity to permit operation part of the time without water; that is, functioning as a straight air cooler. Satisfaction with evaporative cooling suggested to Chief Engineer Vander Veer the possibility of adding a bank of coils to the cooler to handle lube oil from the engines, thus eliminating waste of cooling water under the present setup. This change is on the list of jobs to be done in the near future, as the staff proceeds to iron out small operating difficulties and to make improvements.

Prime-Mover Governors

All prime movers, both turbines and diesels, are fitted with Woodward hydraulic governors. Normal operation, of course, involves loading the turbine as heavily as steam demand will permit, using one of the diesels to fill in the peaks when coincidental steam demand is low. In summer, diesels carry most of the load.

Division of load when both turbine and diesel are running is accomplished by adjusting the speed-droop and load-limit controls of the governors so that one machine runs essentially on base load, while the other floats and controls frequency. Either winter or summer there is ample reserve capacity since power load rarely exceeds 250 kw. Load growth will cut into this reserve and provision is made in the layout for an additional unit when needed.

Electrical System

New switchgear consists of four generator panels, a low-tension panel for power-house services and a high-tension panel for the distribution system. This is 4160/2400-volt, 4-wire, Y-connected, 3-phase, 60-cycle, and most of the feeders run underground to transformers at load centers.

The steam-distribution system consists of about 2 miles of tunnel and RicWil conduit. Steam is used at line pressure (30-lb) for water heating and cooking in various buildings, and reduced at each building for heating. The heating system consists of direct radiation, with orifices, and Webster-Tallmadge control. Under this arrangement, the operator at the power house controls percentage of heat furnished the buildings, in accordance with outside temperature, by means of electrically actuated "heat-motor" valves located in each building.

Will It Pay?

What did all this cost and will it pay out? The answer based on present scanty operating data, but backed by careful, conservative estimates, is "yes". Investment in the plant was kept at a minimum, not by skimping on essentials to good operation, but by simple design, without frills. Further savings resulted directly from the ability and versatility of the college engineering staff. Design and layout of the mechanical equipment, as well as its selection, was in the hands of G H Vander Veer, Chief Engineer. The architectural design, to harmonize with other campus buildings, was executed by Shreve, Lamb and Harmon, of New York, architects for Connecticut College. Major equipment was erected by manufacturers or contracting organizations, but substantial savings resulted from the ability of the engineering staff to handle erection of minor equipment and piping.

Starting with the small turbine and parts of the building shell, the plant was rebuilt and expanded for $114,000 actual outlay. Insurance covered the replacement of the old stack. The total cost was broken down into two appropriations, the first, of $70,000, covering boilers, stokers, accessories, the large turbine, coal-storage and handling equipment, and some building remodeling. The second appropriation, of $44,000, covered the diesels and accessory equipment, and addition of a wing to the building.

Keeping Record Straight

To keep the record straight, the power plant bills the college for power at the old utility rate, with appropriate charges for steam and other services. Accurate records of operating costs are kept and the difference between costs and billings represents either a net saving or loss from power-plant operations. The first half-month's operation (from opening of school in the middle of September) showed a gross profit of $650, from which, of course, fixed charges must be taken. With the turbine loaded to utilize all exhaust steam for byproduct power generation and with diesel power for low-cost summer, peak and standby capacity, there seems to be no reason to doubt that the plant will prove a profitable venture.

LETTERS FROM A TURBINE SPECIALIST

No. 4—On Generator Overloads

By F S KOHL and
L P SHILDNECK
General Electric Co, Lynn, Mass.

Turbine Specialist
District Office

Dear Mr Specialist:

Since your last visit something has come up on which I would like your opinion. As you know, our plant load has been increasing rapidly, and it will be a great help to us if we can plan on overloading one of our larger generators. Ordinarily, of course, this would not be permissible. However, if we were to install an oversized air cooler, couldn't overloads be carried satisfactorily? Here is my reasoning:

Specifications state that at full load and with a 40-C ambient air temperature, the temperature rises will not exceed 60 C for the armature and 85 C for the field. These total up to 100 C and 125 C respectively. Now, with an oversized cooler of the proper capacity, the air temperature could be reduced enough so that with the increased rises due to a given overload, the total temperatures would still be within these figures. This being the case, would we be hurting the generator any by overloading?

As a precaution against overheating, we could make frequent checks on the armature temperature detectors, and, if too hot, back off a little on the load.

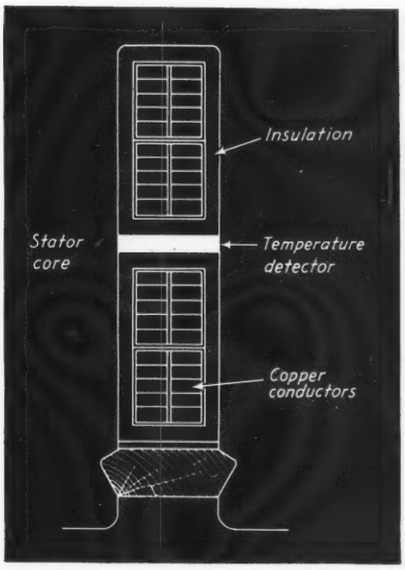
The idea seems pretty good to me, as I can't find any error in my reasoning. I will admit I am a bit skeptical because it seems so simple. How does it look to you?

Very truly yours,
Engineer

Dear Mr Engineer:

While your reasoning apparently proves your idea, there are several other factors that will more than *disprove* it. It is an interesting question and I'd like to discuss it with you in more detail on my next visit. In the meantime, perhaps these comments will help.

It is widely but falsely believed that temperature is the only limiting factor in determining the maximum safe load that a generator can carry. Even if the measured temperatures are kept within accepted limits, operating at overloads may seriously decrease the life of the generator, and may at the same time present severe operating difficulties.



Temperatures are measured outside the coil insulation. Heating occurs inside

Here's what happens. The temperature of the armature is determined by detectors in the coil slots of the iron core in direct contact with the *outside* of the coil insulation. The increased current due to the overload causes increased heating in the copper conductors. This heating (which increases as the square of the current) occurs, of course, on the *inside* of the insulation. With a lower air temperature, you would be able to carry a certain overload and still keep the outside insulation temperature at its limit. But the inside insulation would overheat, dry out, become brittle, and deteriorate.

Just as important as the actual insulation temperature, is the *difference* in temperature between the copper conductors and the core retaining them. Overloads, as already pointed out, increase the conductor temperature and cause them to expand considerably more than under normal conditions. Increased expansion means increased relative motion between coils and core, which in time may cause cracks and air pockets in the insulation leading to a grounding of the coils. During movement under repeated overloads, any dust or dirt on the coils will act as an abrasive and hasten breakdown.

Overloads at constant power factor and voltage require increased field current as well as increased armature current. With proper precaution, it is possible to determine the average temperature of the field coils with a reasonable degree of accuracy by the resistance method. However, here the effect of relative motion between coils and core due to the increased temperature difference is even more pronounced than in the armature. Expansion of the copper increases pressure on the insulation and this may also hasten its breakdown.

The increased excitation required for overload operation increases the mechanical stresses resulting from a short circuit. A sudden short circuit would subject the generator to unusually strenuous duty just when it is needed most.

When operating within rated load, a generator is remarkably stable. It will satisfactorily maintain voltage and its synchronism with other electrical machinery even when subjected to rather severe load disturbances. When overloaded its stability is decreased. Operating difficulties may result, and in plants where temporary outage affects production work, this factor is of extreme importance.

Design margins are such that when operated within rated capacity, a generator can satisfactorily handle normal and emergency conditions encountered in service. But it is not designed, either mechanically or electrically, to operate at sustained overloads, even though measured temperatures are kept within safe limits.

Bear in mind that if we were to design a generator for operation above its nameplate rating, we would use heavier and more substantial parts throughout. In fact, we would not encroach on our factors of safety, but would design for ample margin at the overload condition.

Very truly yours,
Turbine Specialist

Hospital Power Plants Need a Doctor!

Many hospital power-service set-ups are sick from lack of skilled engineering attention. Here are some of the things wrong, and what to do about them, taken from a paper presented at Annual Convention of American Hospital Association, Toronto, September 27

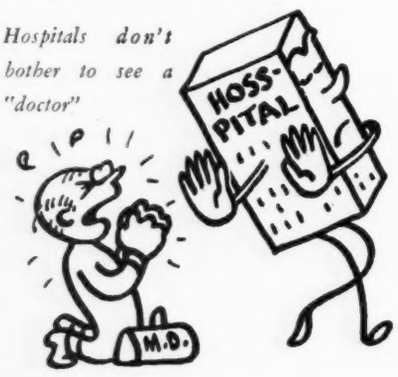
By PHIL SWAIN
Editor of Power

I HAVE BEEN ASKED whether hospital managers take their power-plant problems seriously. My answer is that they take these problems "seriously", but not intelligently.

When it comes to engineering sickness, hospitals generally don't bother to see the doctor (that is, the competent engineering consultant). And where they do, they frequently fail to follow his advice, pleading lack of funds. To put this bluntly, the hospital is too poor to afford to cure its mechanical ills. Yet, it is poor because it has not taken the cure.

Some time ago, when I started to give a little thought to this paper, I seriously considered making a survey of the actual mechanical set-up in several hundred hospitals. The questionnaires were about ready to mail out when a good friend, a hospital engineer, warned me in no uncertain terms to "lay off".

Come to think about it, a typical hospital power-survey return, if it could be obtained, would necessarily read something like this: Yearly heating cost—"don't know". Cost of steam per 1,000 lb—"don't know". Steam consumed in laundries per 1,000 lb of wash—"don't know". Boiler evaporation per lb of fuel oil—"don't know" . . . and so on.



Hospitals don't bother to see a "doctor"

As I see it, the basic causes for wastefulness in most hospital power-service organizations are three:

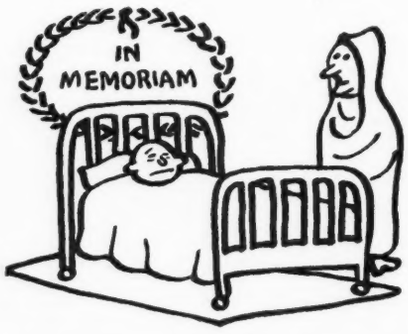
First is a financial set-up that makes it difficult to obtain money for any items whose usefulness is not obvious to the medical profession, the donating public, and the potential patients—even where the proposed expenditure would definitely benefit all three groups.

For example, Mrs Jones endows a bed in loving memory of her departed husband. You never hear of her endowing a zone control for the heating system, or an evaporative condenser for the refrigerating plant, yet such an investment might cost Mrs Jones less in actual cash, and, in truth, constitute a bigger medical service to the community, because the saving from the mechanical installation might pay for the operation of two or three beds.

The second basic cause of waste is the common failure to work a thoroughly trained engineer into the picture in a position of real authority, and to pay the market value of such a man.

The third reason is that most hospitals have a completely inadequate power-cost system, and also refuse to install the meters that would make possible an intelligent cost system.

Hospitals are innocently wasting millions of dollars every year by pooling heat, light and power costs and allocating the total to departments on some fixed basis. The loss does not lie in the faulty allocation itself, but in the failure to change the allocation month by month as actual consumption changes. The system of charging power costs on a fixed percentage basis neither spots the dollar leaks nor gives department heads any real incentive to find and correct them.



Mrs Jones endows a bed in loving memory of her departed husband

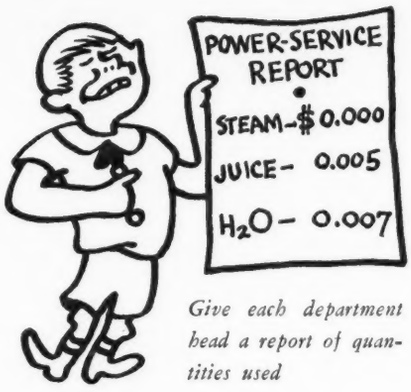
Without a doubt, the first step in cutting power-service costs in any hospital is to put in some meters. What meters? The answer is to start with those that will make the biggest showing for the smallest investment. I would suggest one or more of the following: Laundry hot water, laundry cold water, feedwater to boiler, oil fuel to boiler.

If possible, divide the institution into several segregated "departments", perhaps by buildings or by management groups. Always treat the laundry as a separate department. Then, as far as practicable, arrange to meter, separately to each department, the cold water, hot water, electricity, and steam (for heating and other purposes).

Assign a unit cost to each service (where possible, the actual unit cost, of course):

1. Electricity at so many cents per kwhr.
2. Cold water at so much per 1000 gal.
3. Hot water at so much per 1000 gal.
4. Steam at so much per 1000 lb.

Then give each department head, each month, a report of the quantities



Give each department head a report of quantities used

used and their total cost. If you do this, or even a halfway job of it, I can guarantee that the effect on your total cost will be astounding. For the first time it will become possible for a department manager to get personal credit for real savings he makes. This knowledge, and this incentive, may easily cut power-service costs in the laundry alone as much as 40% in a single year.

In the same way, steam waste through careless operation of heating systems will be cut down everywhere, as department heads aim to make a better showing on their books. Overheated rooms will be cooled otherwise than by opening windows. Unneeded lights will be switched off. Consumption of every power service will go down in all departments. It is quite possible that the aggregate of these savings for the whole hospital will pay for all the meters within the first year—certainly within the first two years.

Waste in the Laundry

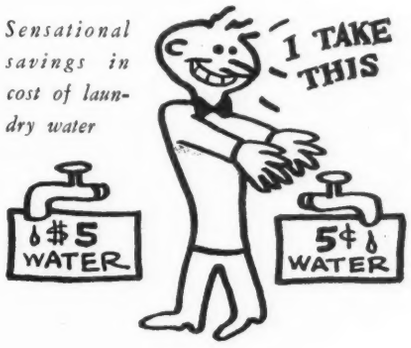
In most hospitals the big steam wasters are the heating system and the laundry. Both should have attention by experts in these fields. The heating expert is likely to recommend a vacuum system. By reducing steam pressure below atmospheric, more moderate radiator temperatures are available for mild weather, with resulting greater comfort and avoidance of the annoyance and waste of opening windows to cool overheated rooms.

Another widely used modern device for saving heating steam is "zone control". Heat required in different parts of a building depends on exposure to sun, direction of wind and other variable factors. By dividing a building into zones, and controlling each separately according to weather conditions, no part is over or underheated and much steam is saved. I recently visited a hospital where steam savings from zone control are yielding a yearly return of 60% on the investment.

I have seen sensational examples of saving in the cost of laundry water through better equipment and operation. Every hospital laundry should install not less than two water meters, one for hot and one for cold water. The laundry manager should receive each month a statement of the hot and cold water used, with the unit cost and total cost of each. These figures should then be reduced to the basis of consumption and cost per pound of wash, so that the operator will not be improperly credited for savings or blamed for a loss actually caused by a variation in the amount of laundry handled.

To be consistent, a meter should also be installed to measure the direct supply of steam to the laundry (other than that supplied in the form of heated water). However, steam meters cost considerably more than water meters, and I would not suggest delaying installation of water meters until money can be obtained for the steam meter. Half a loaf is better than none.

Very often an old or badly arranged refrigerating plant is a great waster of power and water, particularly the lat-



Sensational savings in cost of laundry water

ter. Sometimes city water is used directly for condensing the refrigerant and then discharged to the sewer. This is very wasteful. An evaporative condenser or cooling tower will eliminate most of this water waste.

Next is the plant personnel. A good hospital engineer must be versatile and cooperative, as well as technically competent and experienced. He must have common sense and ingenuity. A sympathetic and cooperative attitude on his part makes mechanical knowledge contribute to medical service without infringing on the doctor's prerogatives. Likewise, the medical men, general hospital supervisors, and directors would do well to utilize the expert knowledge of the engineer.

If the hospital is small, it may be difficult, with the funds available, to obtain an engineer with practical qualifications plus technical training. Here it may be advisable to retain a consulting engineer or engineering firm on an annual fee basis to survey the plant and operations at intervals and suggest savings. Where a community has several small hospitals, they may band together to engage such service.

But when all is said and done, I find the big question is always this: "Where will we get the money?" This is particularly true of hospitals.

A Constructive Proposal

Suppose we meet this objection on its own level with a constructive proposal: "All right, let's take last year's actual expenditure for heat, light and power as the budget for the next few years. Also, let's depart from orthodox business procedure by including capital expenditures as part of the operating budget".

Under this set-up, a smart engineer or superintendent can go places. The first year he starts by making some obvious service savings. These pull his operating costs under the budget and he uses the difference, perhaps only a few hundred dollars, to buy a few essential meters. Their installation immediately creates further savings, permitting the purchase of more meters or other saving devices.

The effect is cumulative. Each thing put in creates savings that go on year after year. In this way it is possible practically to build a new plant without asking for a penny of appropriation or incurring any future liability. What board of governors could object to that —particularly since the result, after a few years, will be a cut of 20 to 50% in power-service operating expense?

P. S.—A month after this speech, five babies were asphyxiated by steam in the nursery of a New Jersey hospital. According to the newspaper account, the radiator valve was held onto the pipe with adhesive tape because "the threads were gone". The tape let go during the nurse's momentary absence and filled the room with steam.

I suppose the next step will be to wrap all the lines with adhesive tape, pack the valves with surgical gauze and sew the fittings up with catgut. Is there a doctor in the house?

But where will I get the money?

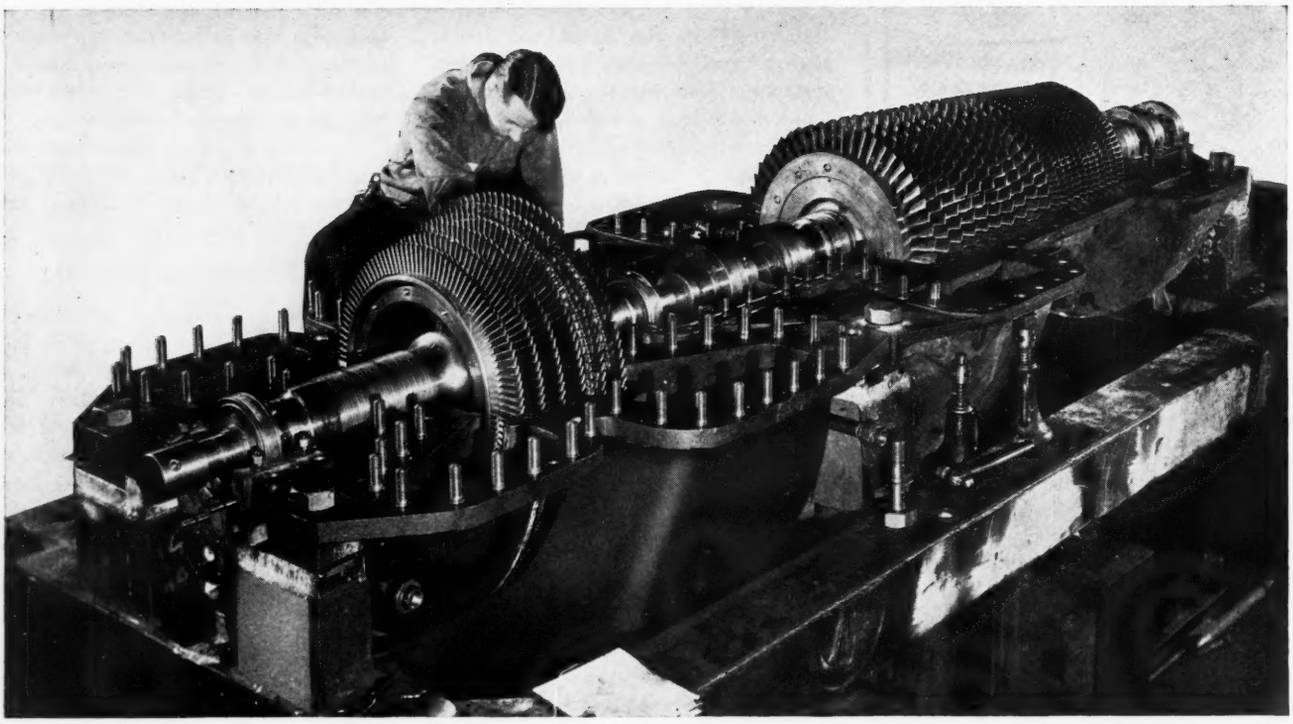


Fig. 1—23,000-cfm, American-built gas-turbine axial-compressor unit with top half of casing removed

Why Combustion Gas Turbines?

With two major obstacles out of the way—developing a compressor of high enough efficiency and metals to withstand 1000 F—American progress gains momentum

By Dr J T RETTALIATA
Steam Turbine Dept, Allis-Chalmers Mfg Co

EVEN IN THE EIGHTEENTH century engineers appreciated the advantages of a prime mover having rotary motion without the complexities that accompanied steam-plant practice. Present-time interest and publicity are turned to the gas turbine because the two main difficulties that prevented practical application of the cycle for so many years have been overcome.

Progress in the development of materials for the steam turbine has produced metals that can withstand the high temperatures which make good gas-turbine over-all thermal efficiencies possible. Years of aerodynamic research have contributed to the high-efficiency compressor unit without which the gas turbine alone would be useless. Thus the steam turbine, which first inhibited the development of gas turbines, has now become responsible for the realization of commercially practical application of the gas cycle.

A modern gas-turbine axial-compressor unit is shown in Fig. 1* A 5-stage reaction-type turbine is directly coupled to a 15-stage axial compressor. Air from the atmosphere enters the compressor where the pressure is raised to 30–50 lb g. Part of the air discharged from the compressor is used for combustion purposes in an oil-burner combustion chamber mounted directly above the turbine, the remainder bypassing the burner to cool the products of combustion to a satisfactory turbine-inlet temperature.

The gas, a mixture of air and combustion products, then expands through the turbine from which it is exhausted to the atmosphere. Power developed by the turbine is greater than that required by the compressor and the excess power drives a generator. A motor brings the unit from standstill up to about 25% normal speed, at which point the turbine is capable of driving the compressor. The unit is controlled by a speed governor connected to the fuel-oil supply. In this way, the inlet-gas temperature to the turbine is varied, thus changing the power developed by the turbine. An emergency governor actuates a bypass valve around the turbine when a designated overspeed is exceeded. The turbine and compressor are connected through a solid coupling which enables their equal axial thrusts to neutralize each other, thus eliminating need for balance pistons.

* For schematic diagram see POWER, June, 1939.

Fig. 1 is a partially assembled unit with the top half of the casing removed. This unit is rated at 23,000 cfm of air at standard conditions. The turbine, at the left, is mounted on a common bedplate with the compressor at the right. Proceeding from left to right along the turbine shaft are located: the emergency governor and the exposed head of its stop bolt whose radial movement releases the bypass-valve trip mechanism upon the attainment of a predetermined overspeed; a turbine shaft bearing; a labyrinth sealing gland composed of radially projecting fins on the shaft which rotate with close clearances in narrow grooves in the casing; the turbine inlet opening; six rows of radial-clearance reaction blading; the turbine exhaust opening; a labyrinth sealing gland (not visible); a shaft bearing; and one-half of the solid coupling at the end of the turbine shaft.

Continuing in the same direction along the compressor shaft can be seen: the compressor half of the coupling which engages the half coupling on the end of the turbine shaft; a shaft bearing; a labyrinth sealing gland similar in construction to that previously described in the case of the turbine; the compressor intake; 21 rows of blading; the discharge opening; a labyrinth sealing gland (not visible); a shaft bearing; and a coupling to which a reduction gear is connected.

Supplementing the turbine and compressor with a generator, combustion chamber, fuel controls and a lubrication system completes the power unit—a power plant characterized by its simplicity. Absent are the intricacies of the steam station with its boiler and auxiliary equipment, water-treatment plant, condenser, pumps, and cooling towers. The gas-turbine plant might well be considered independent of geographical location in that its working medium, air, is universally available. No special sites near water supply systems are necessary.

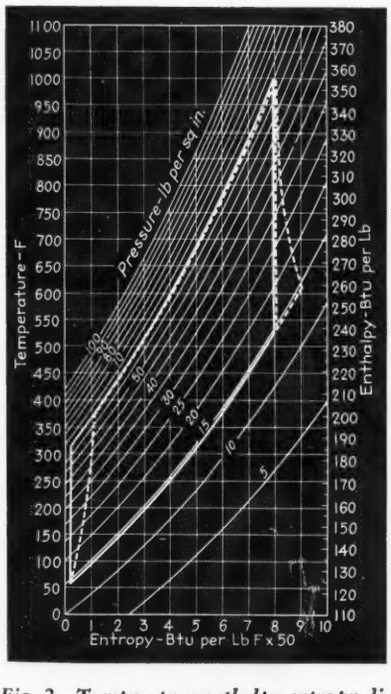


Fig. 2—Temperature-enthalpy-entropy diagram for air showing gas-turbine cycle

The combustion gas turbine operates on the well known Brayton cycle consisting of two isentropic and two isobaric lines, Fig. 2. Solid lines are theoretical, dotted ones actual.

Assuming that the composition of the gas in the turbine is the same as the air in the compressor for simplification (fuel added to raise temperature is less than 1% of air quantity), the net power output of the cycle can be determined from the temperature-entropy diagram of Fig. 2. The enthalpy scale at the right is the result of multiplying the specific heat of air at constant pressure by the absolute temperature.

Example

In the theoretical cycle (solid lines), the work of compression per lb of air is 187 — 125 = 62 Btu per lb. Actually, however, with an 81% efficient compressor (dotted lines), the work is 76.6 Btu per lb. Actual air temperature at compressor discharge is about 370 F.

In the combustion chamber, heat is added to raise the temperature of the air to about 1000 F or 355 Btu per lb. Assuming an 83% efficient turbine, 96 Btu per lb are converted into work and the exhaust gas is discharged still containing 259 Btu per lb at 612 F.

In the gas-turbine cycle, this discharge of hot gas to atmosphere represents a waste in the same way and of about the same magnitude as in a steam boiler without heat-recovery apparatus.

Such degradation of energy naturally hinders economical operation. One of the various methods by which the thermal efficiency of the gas cycle may be improved is by use of a heat exchanger. In this manner the exhaust gas from the turbine can be utilized in raising the temperature of the air discharged from the compressor.

The introduction of a heat exchanger must be undertaken with caution, however, as an excessive pressure drop through it may easily nullify any increase in efficiency that could otherwise be realized. Nevertheless, when properly designed, improved performance is readily attainable as shown in Fig. 3.

The curves in the figure indicate that thermal efficiencies range from a peak value of 16% when no heat exchanger is used, to 24.5% obtainable with a heat exchanger having a surface of 30,000 sq ft. It will be noticed that the peak efficiencies occur at various pressure ratios in the compressor for different heat-exchanger surfaces, thus indicating the necessity of designing the compressor and heat exchanger as a unit, to insure the proper amount of surface being associated with the correct pressure ratio.

Effect of Pressure Ratio

For any given turbine inlet temperature, there is one compressor pressure ratio for which the over-all thermal efficiency of the unit will be a maximum, as shown in Fig. 4. For purposes of comparison, the curves are based on the assumption of no pressure drop existing between compressor discharge and turbine inlet. An examination of the curves shows that approximately a linear relationship exists between turbine inlet temperature and pressure ratio for the realization of maximum efficiency.

The sensitivity of the cycle to temperature is effectively displayed by a doubling of thermal efficiency when the temperature is increased from 600 F to 800 F.

Another reason for the gas turbine remaining in the background during its long development period may be had from the lower temperature curves in Fig. 4. The poor thermal efficiencies shown for these curves must be decreased still further when the losses of an actual cycle are taken into account. Small wonder then if the developers of the early gas turbines made slow progress when limited temperatures were imposed by inferior materials.

The maximum normal operating temperature of any of the gas-turbine units built by Allis-Chalmers to date has been 1000 F. The 1200-F curve is exhibited to demonstrate possibilities of projected development. Research on blading materials indicates that this higher temperature may be considered practical in the not-too-distant future.

Over-All Efficiency

The over-all thermal efficiency of the theoretical cycle as a function of pressure ratio for various efficiencies of turbine and compressor is shown in Fig. 5. The importance of high turbine and compressor efficiencies is strikingly brought out, for increasing these efficiencies from 75 to 90%, a 20% change, results in a 400% increase in maximum thermal efficiency obtainable.

The curves are all based on a tur-

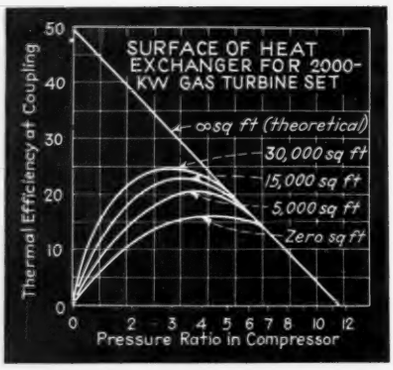

SURFACE OF HEAT EXCHANGER FOR 2000-KW GAS TURBINE SET
∞ sq ft (theoretical)
30,000 sq ft
15,000 sq ft
5,000 sq ft
Zero sq ft
Thermal Efficiency at Coupling
Pressure Ratio in Compressor

Fig. 3—Heat exchanger increases thermal efficiency as in steam practice

bine inlet temperature of 1000 F. Their trend will naturally be upward when future materials warrant safe operation at higher temperatures.

It will be noticed that the peaks of the various curves occur at different values of pressure ratio. Maximum thermal efficiency depends upon the correct association of pressure ratio with combined efficiency of turbine and compressor.

Here again is emphasized the need of a highly efficient turbine and compressor. Only because the modern gas-turbine axial-compressor unit possesses this necessary high efficiency is the cycle commercially practicable today.

In certain chemical processes gas-turbine axial-compressor units are used for supercharging. High-temperature gas returned from the process is furnished the turbine for the development of power. In some of these instances, the pressure drop in the process is high enough to reduce to zero the excess power which would otherwise be obtainable with a moderate drop in pressure. Such inefficiency is only tolerated, however, in these special cases where the primary concern is the delivery of air and not power production.

Effect of Injecting Water

Water injected into the combustion chamber will increase the excess power developed by a given size of gas-turbine axial-compressor unit. Such a procedure, while augmenting the output of the unit, is, nevertheless, an inefficient practice owing to the latent-heat-of-vaporization loss at the turbine exhaust. If indulged in extensively, the reduction in over-all thermal efficiency may prove prohibitive.

At the present time the principal commercial application of the gas-turbine unit in the United States has been in oil refineries. Air discharged from the compressor is used in a process and the resulting high-temperature gases are expanded in the turbine, producing power, the excess of which is supplied to a generator. In this arrangement, therefore, no combustion chamber is required as the process itself acts in this capacity.

Many gas-turbine units operate as superchargers in the Velox boiler, developed by Brown-Boveri, where the boiler-exhaust gas drives the turbine.

A 4000-kw unit is being installed in an emergency-standby power station in the city of Neuchatel, Switzerland. Its

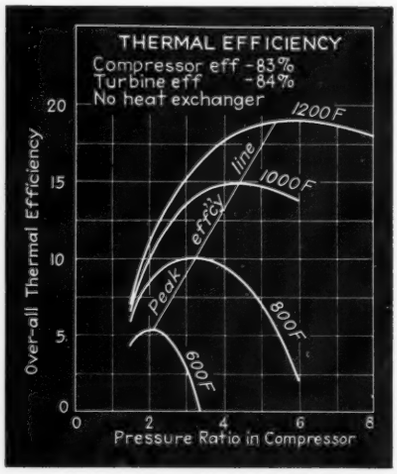


Fig. 4—High operating temperatures offer relatively large efficiency gain

simplicity and independence of water facilities ideally adapt the gas turbine to this class of service.

Allis-Chalmers is at present investigating the possibilities of the gas turbine as a drive for locomotives. Both electrical and mechanical transmissions are being studied as well as the merits of the hydraulic coupling.

Numerous other natural and favorable applications of the gas-turbine-axial-compressor unit will develop from time to time and probably include marine propulsion, blast-furnace plants, wind tunnels, special power plants, and other special applications.

At the present time the continuous-combustion gas turbine is being carefully investigated by Allis-Chalmers. Five units have already been constructed to the designs of Brown-Boveri. Field experience with these machines should provide basic data for the future application of this power cycle.

Destiny

The advantages associated with the elimination of the high-pressure, high-temperature steam boiler and the attendant feedwater problems from a power plant are obvious. There is, on the other hand, a lack of experience with certain features of the development; further data are necessary on the effect of high-oxygen-content gas on blading materials at temperatures around 1000 F and some other matters. Reliable combustion control to prevent gas of excessive temperature reaching the turbine blading is also a problem.

The destiny of the steam turbine is not being decided by the gas turbine, nor is the future of the former even slightly jeopardized. The gas turbine must develop approximately four times as much energy as it now delivers as excess; its bid as a serious competitor to large steam turbines requires considerable development to overcome present physical limitations. In moderate sizes, however, it will become an aspirant in the power field when higher operating temperatures are permitted by improved methods of blade cooling and materials with better creep and other high-temperature properties.

Direction of Development

At present, the cycle can only be applied where liquid or gaseous fuels can be used, although research has shown some promise for application of

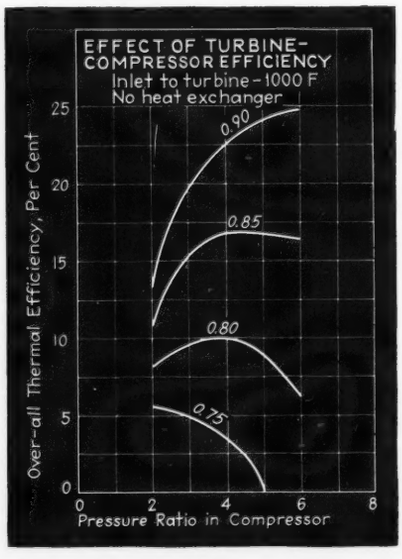


Fig. 5—Over-all efficiency as affected by turbine and compressor efficiencies. Numerals on curves indicate respective values of turbine and compressor efficiencies

pulverized fuel. There are certain present applications where, among other things, weight and freedom from feedwater and condensing water problems make the cycle attractive. It is toward the proper, natural and favorable application of such a unit that the present development is being directed. It is believed the gas turbine has a natural field of applications and it is not regarded as a competitor to large-power-generating units.

Worm Gears Save Space for Draft-Fan Drive

By E J MORGAN
De Laval Steam Turbine Co

A NEW BLAST FURNACE recently added to the Indiana-Harbor plant of the Inland Steel Co required an additional blower, which was installed in an existing engine room. All boilers supplying this engine room, with their settings and auxiliaries, were already operating at maximum capacity and no space was available for an additional boiler. The alternative was to increase the fuel-burning and steaming capacity of four boilers by raising them to increase their furnace volume, and by installing induced-draft fans.

When boilers supply fluctuating loads, adjustable-speed drive on induced-draft fans is of great advantage. A large saving in power results from varying speed of the fans according to draft requirements. Regulation of the draft by control of fan speed with engine or turbine drive is more easily done by either hand or automatic-control equipment than by damper with one or two fixed fan speeds.

Two fans were planned for each boiler, or a total of eight for the four. Each fan required 185 hp at a maximum speed of 500 rpm and 25 hp at 250 rpm, the two fans giving a total range of draft regulation of 4 to 1.

Placing the Fans

The only place for the fans was directly over the boilers and, as may be seen from Fig. 1, the shafts extend at right-angles to the front of the boilers. It was, therefore, necessary to put the driving units either in front of the fans or behind them, extending towards the rear of the boilers. The usual turbine and helical-gear drive, if placed in front of the fans, would have extended out over the engine room beyond the traveling-crane rail, and with the rear arrangement, would have interfered with the boiler drum, headers and other parts.

After studying various drives, worm gears were selected and the drive turbines placed at right-angles to the fan shafts. Eight velocity-stage turbines transmit power through 6.8-to-1-ratio worm-gear units, rated at 185 hp each at 3420-rpm turbine speed. The worm wheels are connected directly to the fan shafts by all-metal, gear-type couplings. The turbines have hydraulically operated valve gears. A lever operated by the draft-control mechanism varies the governor leakoff to hold speed constant at any point between 250 and 500 rpm. This arrangement has solved the space-limitation problem and has performed satisfactorily under all conditions of operation.

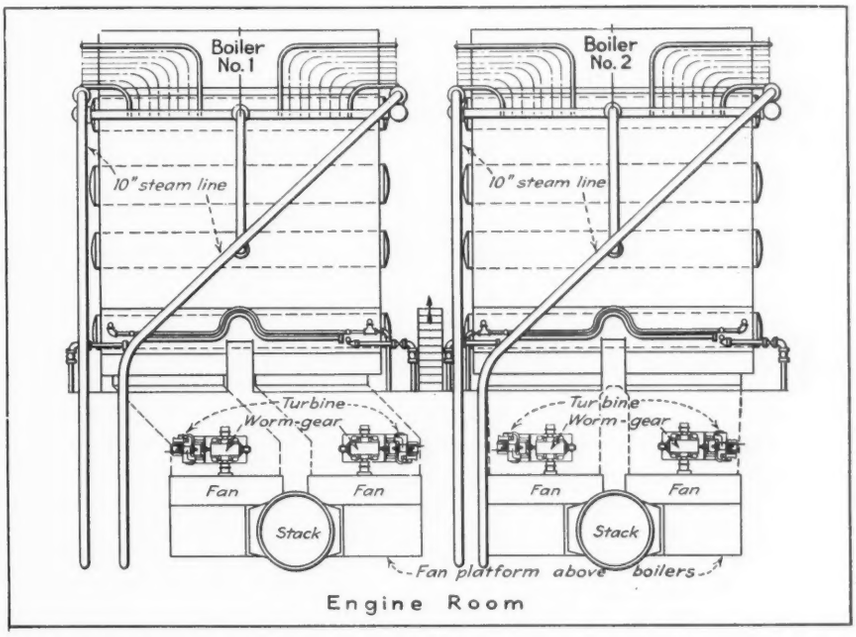


Fig. 1—Plan of two of four boilers shows the tight squeeze between boilers and induced-draft fans, also location of turbines and worm gears

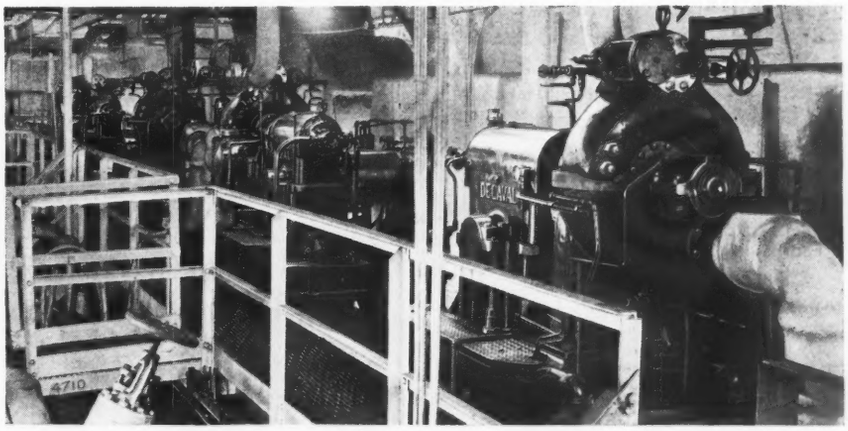


Fig. 2—Four of eight 185-hp steam turbines driving induced-draft fans through right-angle, 6.8-to-1-ratio worm gears at Indiana-Harbor plant of Inland Steel Co

How About Low-Fusion Coal?

Analysis of typical case shows how price difference between low- and high-fusion coal wiped out extra cost of larger pulverized-coal furnace required and produced worthwhile net savings

By CARL A MARSHALL
Consolidation Coal Company

CONSULTANTS, designers, operators and management all work toward the successful use of coals that will produce the lowest possible unit cost of steam generation. This is particularly true of pulverized-coal firing, as the range of coals available is wide.

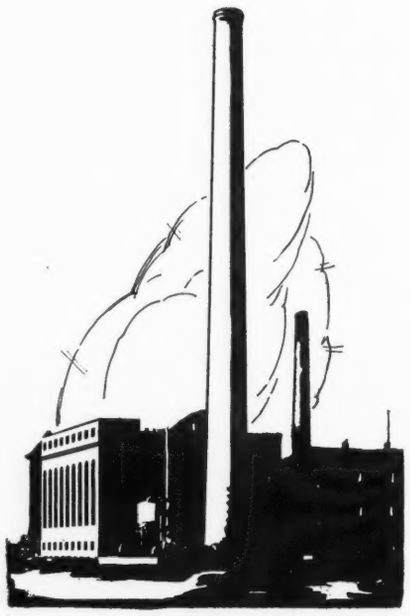
Progress in the design of pulverized-fuel burning equipment has been rapid in the past few years. Many earlier installations were conversions, with increased capacity from a given boiler as the goal. Because conversion of old equipment was expensive, they were seldom equipped with waterwall furnaces and often the refractory furnace volume was insufficient to utilize lower-fusion coals than were used in the hand-fired or stoker equipment which preceded the conversion. This limited the range of coals which could be used.

Then too, there was a tendency to install pulverizers of limited milling capacity, because, as a general thing, the high-fusion coals run low in volatiles (about 16 to 26%) with a high grindability factor. Some of the completely new jobs were similarly designed, usually with air-cooled walls, which slightly reduced furnace temperature and so permitted increased heat liberation per unit of furnace volume. Gradually, furnace sizes were increased, water walls became standard, and grinding capacities of pulverizers were increased. Today it is general practice to install milling capacity based on either 50 or 55 Hardgrove grindability factor.

Thus, it is evident that equipment manufacturers now tend to design pulverizers for use of high-volatile coals. I feel that this trend is inevitable for two primary reasons: first, because of the competitive position enjoyed by the high-volatile producing fields; second, because efficient combustion is obtained with not more than 65% of 200-mesh fineness as against a minimum of 80% of 200-mesh pulverization for low-volatile coal. However, I think that at least 85 or 90% should pass a 150-mesh sieve, at least 90% a 100-mesh and 100% through a 50-mesh, in order to maintain complete ignition and burning in suspension.

Most of the Eastern high-volatile coals, that is, those mined in the Appalachian fields, are well within the minimum grindability index of 50 or 55 Hardgrove. Thus there is no longer any necessity for spending more money to get suitable pulverizers when considering design for high-volatile coals.

Generally speaking, modern installations of pulverized-fuel equipment have furnaces of ample capacity for these coals. However, when designing expressly for low-fusion, high-volatile coals, there are certain refinements which are worthy of particular attention: (1) sufficient furnace volume to hold maximum heat liberation down to 30,000 Btu per cu ft per hr, and (2) maximum radiant heating surface.



Improvement in design of pulverized-coal equipment will undoubtedly continue and we may expect further increases in radiant heating surface, improved arrangement of slag screens and lower tube banks, and better methods of conveying the finer sizes of slack coal. Most new installations have steep bunkers to prevent sticking of wet coal, but there are many plants which have trouble from this source.

Now let's consider the design of a new pulverized coal plant with the idea of using low-fusion, high-volatile coals for low-cost production. For 100,000-lb-per-hr capacity, or higher, minimum investment will result from selection of equipment to burn coals running around 100 Hardgrove grindability factor. However, by increasing the investment not more than 7 or 8%, equipment can be purchased that will burn at high efficiency, the lowest-cost slack

TYPICAL PROXIMATE ANALYSES

Pittsburgh Seam, Fairmont and Greensburg Slack Coals

	Fairmont	*Greensburg*
Moisture, as loaded	4.00 %	4.00 %
Volatile, dry basis	37.47 %	32.40 %
Carbon, dry basis	55.99 %	61.15 %
Ash, dry basis	6.54 %	6.45 %
Sulphur, dry basis	2.16 %	1.00 %
Btu, dry basis	14,133	14,400
Fusion Point of Ash	2170 F	2700 F
Hardgrove Grindability	60	58

coal, namely, Eastern high-volatile, low-fusion slack. By taking a typical case, let's see whether operating savings justify this added first cost.

Let's assume we're going to install a boiler unit to carry a nominal load of 100,000 lb per hr. Experience seems to show that if the design expressly provides for low-fusion coal, no additional maintenance or operating labor costs are incurred. Thus the problem boils down to a straight comparison between fuel savings and increased investment in choosing between the low- and high-fusion designs.

As base coals for this comparison, take a Pittsburgh Seam, Fairmont slack as the low-fusion fuel and a typical Pittsburgh Seam, Greensburg District slack as the high-fusion coal. The table gives the representative proximate analyses of these two coals. They are almost identical in ash content and grindability, but the Fairmont coal has two things against it: lower heating value and lower ash-fusion temperature.

The boiler in question is a 3-drum, bent-tube unit, fired by two horizontal burners, rated at at 6000 lb per hr each, with a single pulverizer, rated at 12,000 lb per hr. Steam is generated at 425 lb and 700 F. The furnace is dry-bottom.

CO_2 in flue gas should be held at 14.5% for the Fairmont low-fusion coal, while the high-fusion fuel will run approximately 15.5%. Calculated over-all efficiency will be 84% for the Fairmont, and 85% for the Greensburg coal. This means that an additional million Btu's input is required if the Fairmont coal is to meet the indicated conditions. Also, we need an increase of 500 cu ft of furnace volume. With this change, the designers put in an additional 200 sq ft of waterwall surface. The increased furnace volume (from 4000 to 4500 cu ft) gives a heat liberation of 30,000 Btu per cu ft per hr instead of 35,000. Combustion products will leave the furnace at 2100 F with Fairmont coal, and 2300 F with Greensburg.

Estimated difference in initial cost to cover increased furnace volume and waterwall surface amounts to approximately $3000, and $2000 more will cover the added setting cost. This brings the total to $5000, or $50 per 1000 lb of steaming capacity. This is about 5.5% increase over the estimated original cost, for high-fusion design.

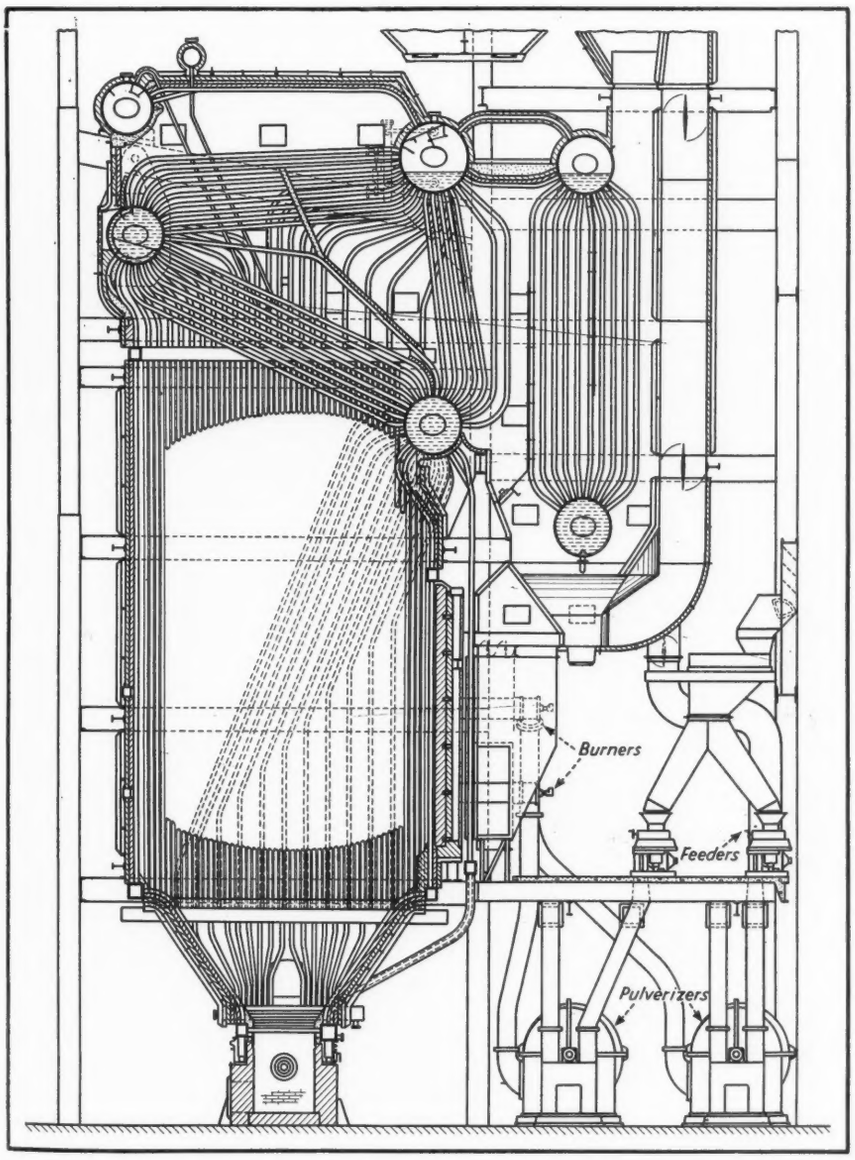
Evaporation is a direct function of boiler operating efficiency. Therefore, based on the builders' guaranteed efficiencies, the comparative evaporations (from and at 212 F) are 12.61 lb for the high-fusion and 12.23 lb per lb for the low-fusion coal. Taking the average competitive price of these two coals over the past five years, namely, $4.21 and $3.84 per net ton, delivered all-rail into metropolitan Philadelphia, we have comparative fuel costs, per 1000 lb of steam, of $.1669 for the high-fusion and $.1569 for the low-fusion.

Actual Savings

This is equivalent to a saving of $1.00 every hour of operation at 100,000 lb per hr load. For 3-shift, 7-day-per-week operation, this would amount to $8760 per year. With this maximum operating condition, the added investment could be written off in much less than a year. For single-shift, 40-hr week operation, representing about the minimum in yearly hours, the saving would be about $2,000, and the investment could be written off in about 3 years.

After the investment has been written off, the only difference between the coals that need be considered is the lower evaporation from the low-fusion coal. As long as the price differential exceeds $.13, it will pay to use the low-fusion coal, in spite of poorer efficiency and evaporation.

However, there is no cause to believe that such a low differential could exist for any length of time, since average production cost in the northern West Virginia low-fusion field runs $.33–$.35 lower than in any of the other high-volatile (high- or low-fusion) producing districts of either North or South. This fundamental factor tends to take some of the uncertainty out of estimates of the probable future coal-price structure. Coals of the type considered here are now available in unlimited quantities from the lowest-cost field in the Appalachian District. These reserves will not be exhausted for at least another hundred years, based on the present rate of consumption.



By burning low-fusion coals in two 350,000-lb-per-hr units like this one, Pennsylvania Sugar Co paid out on the investment of close to a million dollars, in seven years

How to Use pH

Control of pH is the answer in many industrial processes, as well as in maintaining proper feed-water treatment. Here are some examples of how pH is used to accomplish certain results

By G A PERLEY
Leeds & Northrup Co

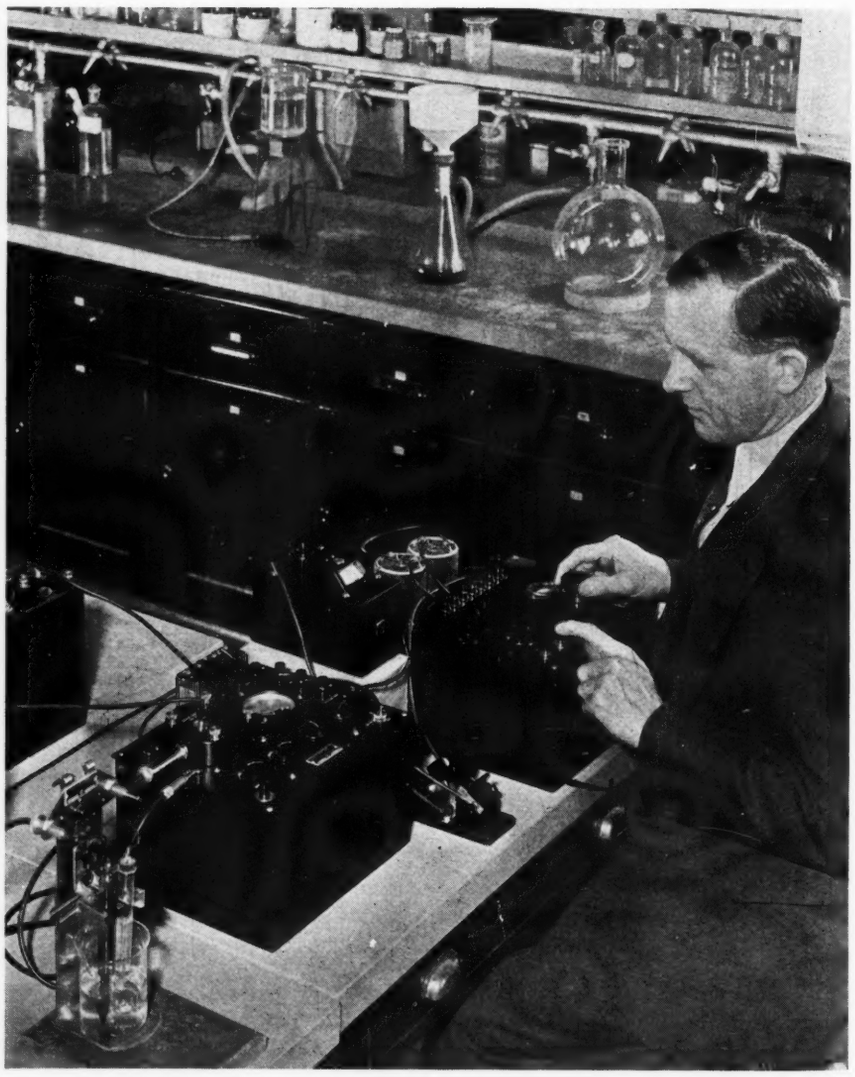
A pH NUMBER is a measure of hydrogen-ion concentration (see "What is pH?", page 78, November POWER), and to judge the significance of pH values it is necessary to have actual experimental information on the effect of variation of hydrogen-ion concentration upon the process in question. Under some conditions, a variation of 0.5 pH involves a change in hydrogen-ion concentration which may have very little influence upon the product, while under other conditions, a change of 0.2 pH may be of importance.

Individual Problems

Each plant has its own particular problems with corrosion of water lines, contamination of condensate, etc, which can be solved only after we understand how pH may enter the picture. One plant may find good results at 9.0 pH, while another feels that 9.5 pH is the lower limit for boiler waters. The choice of the best pH value between the limits of 7.5 to 8.5 pH, for reducing corrosion of galvanized iron by brine solutions in the presence of sodium bichromate, depends upon the brine and bichromate concentration.

Although the pH value of pure water is 7.0 at 71.6 F, the natural waters may vary considerably, but generally come within the limits of 6.5 to 8.0 pH. When pure distilled water remains in contact with air, it may have a pH value between 5.5 and 6.5 pH due to the solution of the small amount of carbon dioxide in the atmosphere. The solution of the carbon dioxide in water produces carbonic acid. For the same reason, the pH value of condensate may come within these limits. If the condensate goes above 7.0 pH, it indicates contamination by the alkaline boiler water.

A conductivity measurement on the condensate is also used to detect contamination from either the boiler water, the cooling water, or both. It is a matter of opinion as to whether it is desirable



The author captures the pH of an industrial solution

to use a pH measurement on the condensate in order to determine whether the contamination may have its source from the alkaline boiler water or from the cooling water of the condensers. The former gives a well defined pH, the latter a negligible pH change.

In any measurement of this type, it is essential to protect the sample from even a slight contamination of air prior to the point where the pH measurement is to be made. Considerable care must be used if we are to obtain a correct interpretation of the data.

The hydrogen-ion concentration of pure water increases with extraordinary rapidity between 32 F and 212 F. It is three times as great at 77 F as at 32 F and approximately seven times as great at 212 F as at 77 F. The ionization of water passes through a maximum between 482 F and 527 F. Thus:

Temp F	*Absolute press., lb/sq in.*	*H ion conc*
32.0	—	$.30 \times 10^{-7}$
71.6	—	1.00 "
212.	14.7	6.07 "
302.	69	15.23 "
392.	225	23.58 "
483.	577	25.83 "
572.	1247	20.00 "
583.	1358	18.57 "

The importance of this table is evident when we realize that iron is not rapidly attacked by moderately high concentrations of hydroxide ion, but is attacked by excessive hydrogen-ion concentrations. The hydrogen-ion concentration of water is 26 times as great at 482 F as at 71.6 F. Thus, sufficient alkali must be added to the feedwater to take care of the excessive hydrogen-ion concentration which results at the higher temperatures within the boiler. Just what the treatment should be depends upon the specific conditions at a particular power plant, yet this indicates how a pH measurement may enter the corrosion problem even if pure water were used.

pH Control the Answer

There are differences of opinion as to whether a lime soda, a zeolite or a phosphate should be used in a feedwater treatment. However, in eliminating objectionable dissolved solids by any method, it is necessary to secure a water which will not have an excess of hydrogen-ion concentration at the boiler-water temperature. Control of pH is really the ultimate answer in any case.

pH control has resulted in many accomplishments. Some of these will be very briefly discussed. Not all of these principles are applicable to power-plant problems, yet they show how pH may be used to accomplish certain results.

Some of the more important functions which have been controlled by pH are the following:

A. Corrosion of materials depends very often upon the specific pH of a solution. When dissolved oxygen is present in municipal waters it has been found advantageous to add lime to the water until it reaches 8.0 pH. A protective coating then forms on the inside of the pipelines, retarding corrosion.

B. Colored impurities may be better absorbed at certain pH values than at other values. Thus, in the removal of color in water, by means of chlorinated ferrous sulfate, a range of 4.2 to 4.7 pH has been reported as most favorable.

C. Effective washing of solids can be attained by pH methods. In a laundry washroom, the goods are subjected to a suds bath where there is soap and sufficient alkalinity to prevent soap specks. The goods must be rinsed; excess rinsing below a certain pH represents waste of water, time and labor.

D. A well defined pH range is necessary for complete precipitation of a particular substance. Paper-mill operators worry considerably over stream pollution. Fillers may be recovered and pollution eliminated by a proper coagulation treatment. This may be done by a soap flocculation in the 6.7-to-7.0-pH range. Then, too, in the most efficient paper sizing, a range of 4.0 to 6.5 pH, depending on the mill, has resulted in complete rosin precipitation and most economical use of alum.

Activated-Sludge Process

E. Rate of settling of a freshly precipitated material may be exceedingly slow, except within prescribed pH values. In the activated-sludge process of sewage disposal, it has been shown that aeration is not effective below 3.0 pH or above 8.0 pH. Filtering efficiency is greatly dependent upon the pH value at aeration and a compromise between these two influences must be made.

F. The grain size of a product formed in a precipitation process depends upon the pH value. In nickel plating, it is customary to maintain acidity between 5.2 and 6.8 pH, depending upon the particular process. Too high pH values give burnt deposits, too low give brighter, more brittle deposits.

G. The speed of a reaction may be either fast or slow within specified pH limits. Thus, in the tannery, the putrifactive bacteria are most active on skins over the range of 5.5 to 6.0 pH, and this range must be avoided. The normal fermentation in the manufacture of beer proceeds best at about 4.5 pH for certain types of wort.

H. Some products may decompose outside of certain pH limits. In cane-sugar refining, inversion of the sugar can be minimized by keeping the liquors above 6.8 pH. In the evaporation of gelatine or glue solutions, decomposition may be retarded by proper pH control.

I. Maximum and minimum swelling effects of protein substances occur at definite pH values. In leather manufacture, the protein substance, collagen, in the hide must be swollen and broken up into fine fibrils. The minimum swelling occurs at 4.7 pH. The swelling increases rapidly on either side of this value.

J. Emulsification of fats and greases can be controlled by pH methods. In the "degumming" of silk in the textile industry, the grease, dirt, etc, are removed. Excessive alkalinity causes damage to the fibers, yet degumming is most effective at 9.0 pH.

The value of the above information is closely related to improved quality of product, greater uniformity, decreased spoilage, increased production and decreased costs.

Determine by Experiment

Control of pH may mean a great deal in one process and very little in another. Experimental measurements under operating conditions will serve to establish the need, as well as the limit of error, of the measurement required in any specific process. These facts for the most part must be established for each mill or plant and this involves definite experimental study.

Indicating pH measurements must first be carried out in establishing the facts. In this case, a precision measurement is desirable. Whether recording pH equipment should be installed for a particular process, and whether a high or a low limit of error is involved, or if automatic control should be provided, depends upon the specific conditions and the results obtained by preliminary study.

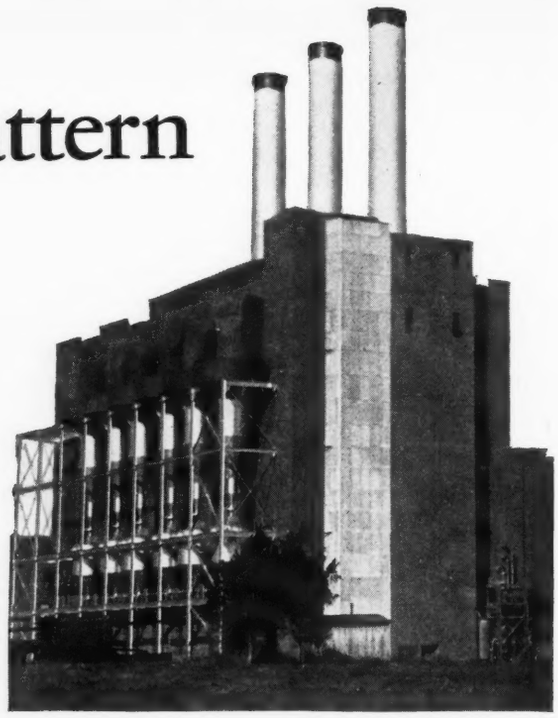
It is relatively easy to establish the most favorable conditions and range of pH required in a specific application. Modern pH equipment makes the recording and control of pH a simple matter.

Measurement of pH is valuable only when facts have been obtained as to what the measurement really means, what limit of error in the measurement must be obtained in order to satisfy the operating requirements, and what the magnitude and frequency of variations may be. Plant conditions vary, but the same fundamentals of pH measurement apply to all.

Process Sets the Pattern at Front Royal

Interlock-protected high- and standard-frequency generators, triple-effect evaporators, and Btu-saving heat balance highlight new Front Royal, Va., plant of American Viscose Corporation

By HARRY A KULJIAN
Philadelphia, Pa.

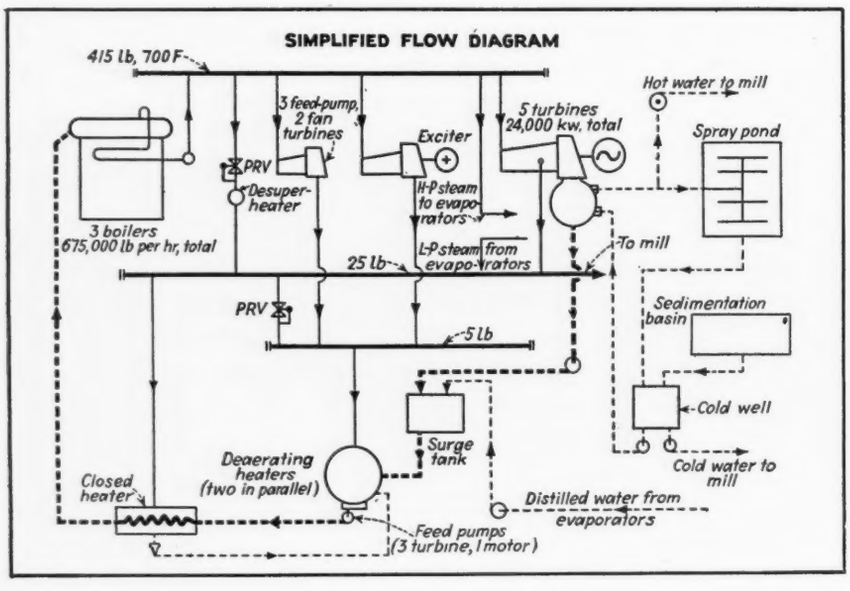


Cyclone flyash separators flank boiler-house wall

GEARED to the special requirements of rayon manufacture, the new American Viscose Corp plant at Front Royal, Va., just put into operation, exemplifies the best modern industrial power practice. The viscose process of rayon manufacture demands an uninterrupted and constant-voltage supply of high-frequency current for spinning-machine motors, 60-cycle power for refrigeration and other plant loads, low-pressure steam for drying, and hot water for washing and bleaching. This makes an ideal setup for a combined power-process steam plant.

Three 225,000-lb-per-hr pulverized-coal-fired boilers supply steam for two 7500-kw, 60-cycle and three 3000-kw, high-frequency turbine-generators. The plant layout, of course, includes provision for expansion. Steam generation at 425 lb, 700 F, gave the best over-all balance between byproduct and condensing power, see flow diagram on this page. Not shown, but important to the power picture, are 1400 tons of refrigeration, comprising two 400-ton, motor-driven and two 300-ton, turbine-driven compressors.

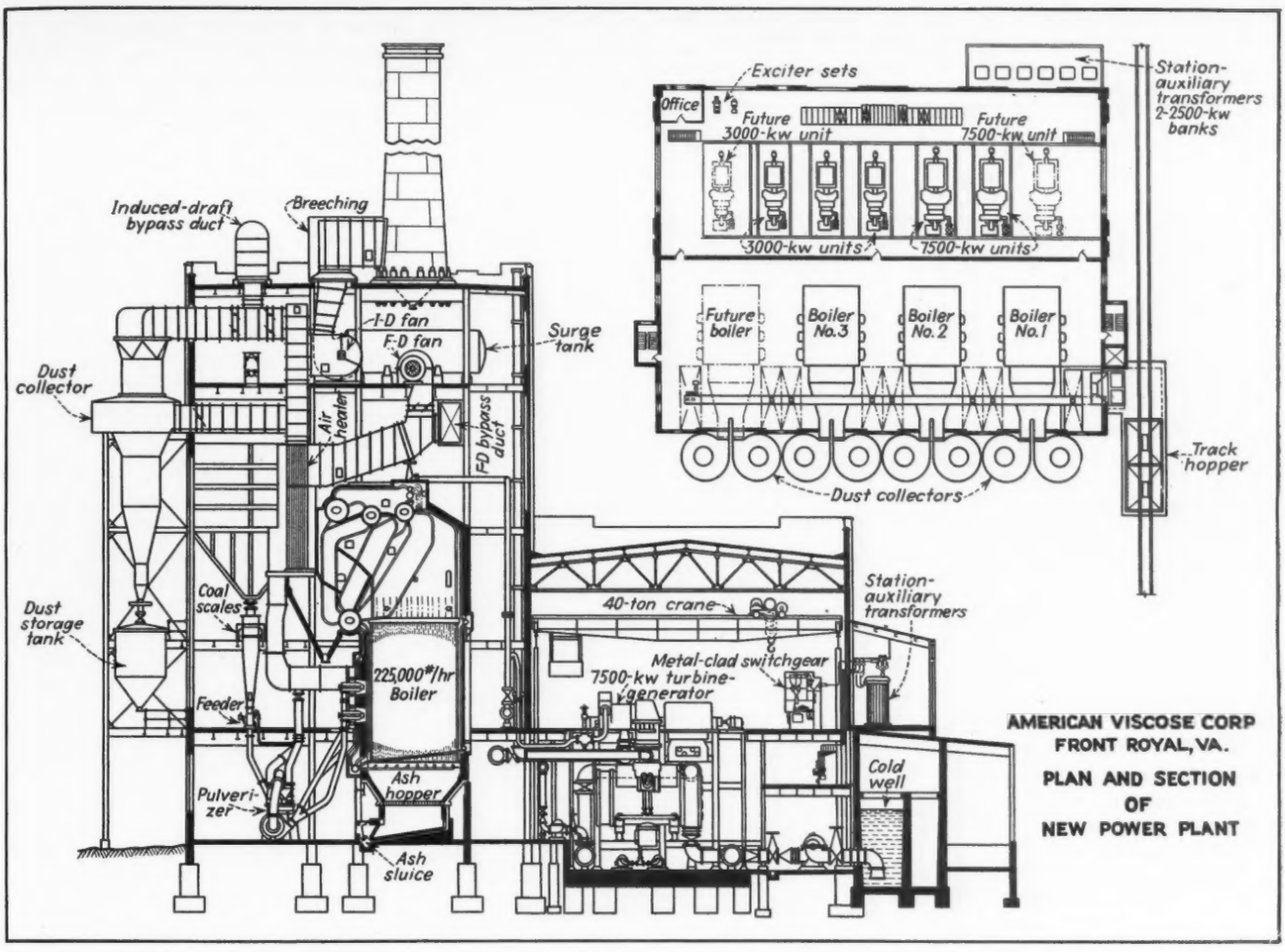
Coal comes to the plant by rail, and cars dump into a 14x28-ft track hopper with a reciprocating feeder. An inclined belt conveyor carries coal to a magnetic separator and a crusher (the latter can be bypassed). A skip hoist lifts coal to a receiving hopper, from where it is discharged by a reciprocating feeder to a flight conveyor in a dust-proof housing. The conveyor discharges through hand-operated sliding doors into raw-coal bunkers alongside each boiler. Each bunker holds a 2-day supply.



Electric interlocks on the raw-coal-handling-system motors start them in proper sequence, from point of delivery at the bunkers back to the track hopper. Should any motor stop, remaining motors between it and the track-hopper-feeder motor shut down in sequence.

Raw coal from the bunkers flows through duplicate circuits to the pulverizers, two per boiler. Each circuit includes a weigh scale, storage hopper and feeder. The operator can see height of coal entering feeders through glass doors at top and bottom of storage hoppers. Interlocks on scale, feeder, pulverizer and draft-fan motors insure starting in proper sequence: induced-draft fan first, then forced-draft, pulverizer, feeder and scale.

The two bowl mills on each boiler can hadle 24,000 lb per hr at 65%-grindability. The index of the coal actually burned runs much higher, but design of pulverizers, burners and furnaces was based on a Pittsburgh slack analyzing 7% moisture, 36% volatiles, 51% fixed carbon, 12.8% ash, 4.3% sulphur, 2000–2400 fusion temperature, and 12,682 Btu heat content. This safety margin insures ample capacity, and gives wide latitude in choice of coal.



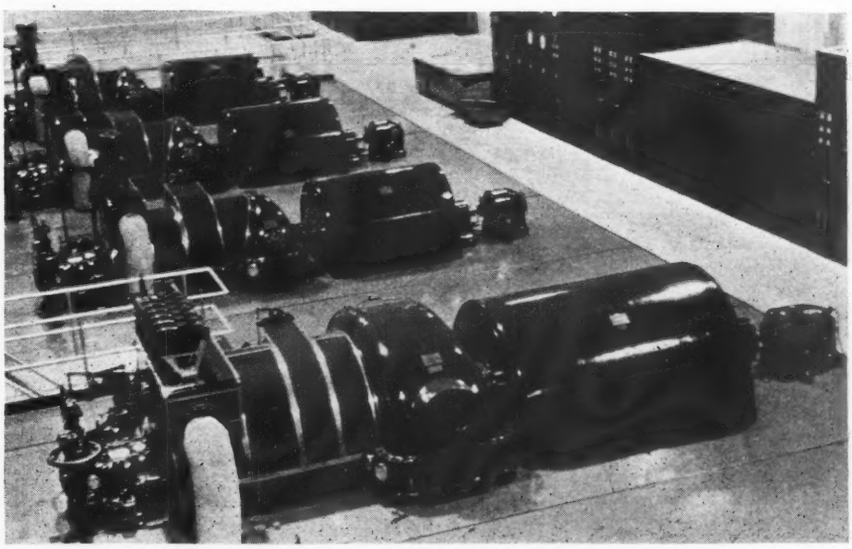
Each pulverizer is fitted with a "Y" casting leading to two burners, so that when boilers operate at low rating, one pulverizer can handle both burners. Thus, repairs can be made to one pulverizer while the other carries the boiler.

Burners fire into water-cooled furnaces with 3-in. plain and fin tubes on four sides. A water-cooled slag screen separates the furnace from the ash-hopper bottom and another similar slag screen divides the furnace and the first boiler pass. Approximately 12,000 cu ft of furnace volume on each unit means that at normal rating, heat liberation will be only 22,500 Btu per cu ft per hr.

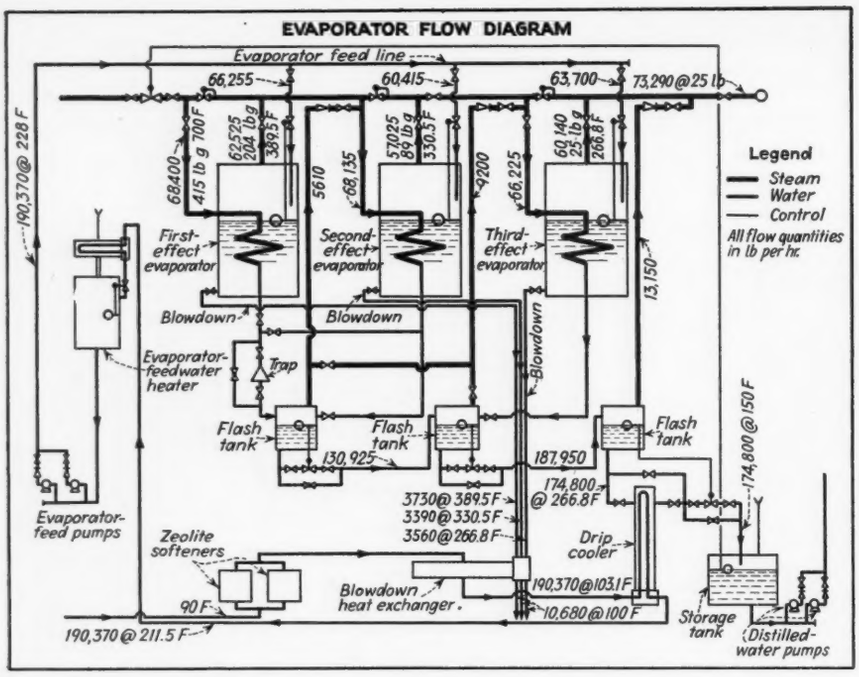
The top saturated-steam drum of these 4-drum boilers contains a steam washer guaranteed to hold carryover to less than 1% when boiler-water solids concentration reaches 3000 ppm. Interbank superheaters raise steam temperature to 700 F at 200,000 lb per hr, normal rating. The superheater permits total temperature to drop only to 650 F at 100,000 lb per hr.

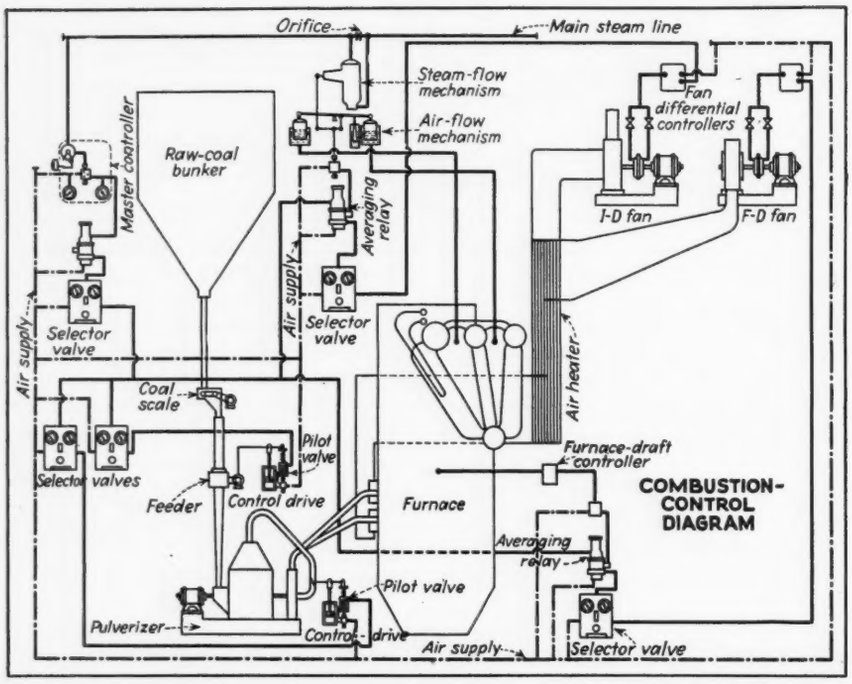
Tubular air heaters on each boiler lower gas temperature from 690 F to 413 F while raising air temperature to 472 F. By fitting a soot hopper to each air heater and by making gas turn through 180 deg at low velocity, much soot and ash is separated from the flue gas. Final separation takes place in cyclone precipitators between air-heater outlet and induced-draft inlet. Based on experience at the Marcus Hook plant of American Viscose, putting the precipitator ahead of the fan will minimize blade abrasion and thus reduce maintenance. At the lower end of the cyclone, a rotary lock continuously discharges collected ash into storage tanks while the boiler is operating.

A hydraulic sluicing system takes care of furnace ash, also soot and ash from air-heater hopper, stack base and collector storage tanks. Each boiler has a hopper bottom, with water-cooled cast-iron walls, separated from the sluicing trough by a single hand-operated door. Ash and soot flow through



Three 3000-kw, high-frequency units; one of two 7500-kw machines in foreground





the sluicing trough to a pit, where a centrifugal pump picks up the material and conveys it through an 1800-ft line for disposal. Ash-sluicing water comes from the plant system.

The air-operated combustion-control system maintains desired steam pressure, and holds correct fuel-air ratio and a constant negative furnace pressure. The diagram shows how changes in header pressure act on the master controller to set up a loading pressure which is transmitted through a relay to a hand-automatic selector valve. According to its position, this valve allows either manual or automatic control. For primary adjustment of fuel and air to load changes, control pressure from the selector valve is distributed through the individual boiler panels, on which are similar hand-automatic selectors, to the drives controlling fuel fed to the furnace and to the hydraulic couplings regulating fan speed.

In addition, averaging relays make other adjustments to fan speed to maintain furnace pressure and air-fuel ratio at the desired points. One averaging relay on each boiler receives a loading impulse from a furnace-draft controller and modifies forced-draft-fan operation to hold a constant and correct furnace draft. Another averaging relay on each boiler receives its loading in pulse from a controller responsive to the steam-flow—air-flow relation of a Bailey meter and modifies induced-draft-fan operation to keep the desired air-fuel ratio.

On one boiler, fans are turbine driven. The other fans are motor-driven, but all have hydraulic couplings for speed control. Supply and drain valves, opened or closed in parallel to increase or decrease amount of oil in the couplings, regulate fan speed. The oil-pump motor runs continuously in one direction, eliminating hunting caused by stops, starts and reversals.

Because of the importance of water treatment to satisfactory operation of high-pressure boilers, careful analyses were made of Shenandoah River water, to be used for makeup. An average analysis for summer and winter conditions revealed the following impurities:

	Ppm
Calcium carbonate	79
Magnesium carbonate	32
Sodium sulphate	12
Sodium chloride	5
Iron and alumina .....Trace	
Organic matter	62
Total solids	190

Evaporators Chosen

Studies showed that evaporators would fit plant requirements best, mainly because demand for low-pressure process steam varies considerably from winter to summer. During four winter months, not enough low-pressure steam can be extracted to meet all demands, so about 80,000 lb per hr would have to be supplied through the reducing valve and desuperheater. By putting about the same amount of high-pressure steam through triple-effect evaporators, the needed low-pressure steam can be taken off the last-stage evaporator, and condensate from all three effects will furnish all makeup required. In other months, low-pressure steam produced from the evaporator hookup reduces amount of 25-lb steam bled from the turbines.

Complete connections for the evaporators are given in the accompanying diagram. Raw water first goes through zeolite softeners, then through a blowdown heat exchanger and a drip cooler into an evaporator feedwater heater. Evaporator feed pumps supply the three effects under float control. Condensate from evaporator coils passes to a series of three flash tanks and then, by way of the drip cooler, to a storage tank. Vapor from the first effect heats water in the second and vapor from the second does the same job in the last effect. Flash tanks are hooked up in the same

Principal Power Equipment

FRONT ROYAL PLANT, AMERICAN VISCOSE CORP

H A Kuljian & Co, Consulting Engineers

Steam-generating equipment:

Boilers, waterwalls.....Combustion Engineering Co
Three 4-drum, bent-tube units, 12,775 sq ft heating surface each, 225,000 lb per hr nominal full load, 250,000 lb per hr maximum load, 425 lb, 700 F. Effective plain-tube surface of waterwalls, 1919 sq ft; effective fin-tube surface, 1704 sq ft. Furnace volume, 12,000 cu ft. Heat release, 22,500 Btu per cu ft per hr at nominal load
Superheaters, Elesco intertube.....The Superheater Co
Air heaters, one per boiler, tubular.....Combustion Engineering Co
Tot. surf, 19,000 sq ft. Air in 80 F, out 472 F, at 200,000 lb per hr
Pulverizers, bowl-mill, two per boiler.....Raymond Pulverizer Div
10,000 lb coal per hr each, on coal with 65% grindability
Ash- and soot-collecting system.....American Blower Corp
Two cyclone ash separators per boiler, with rotary valves
Soot blowers and water columns.....Diamond Power Specialty Co
Combustion control.....Bailey Meter Co

Draft equipment:

Forced-draft fans, one per boiler.....American Blower Corp
Double-inlet, double width, capacity 70,000 cfm at 80 F, 10.5-in. water static press., two driven by GE, 3-phase, 440-volt, 1200-rpm, ac motors, one by steam turbine
Induced-draft fans, one per boiler.....American Blower Corp
Double-inlet, double-width, capacity 135,000 cfm at 450 F, 10-in. water static press., two driven by GE, 3-phase, 440-volt, 1200-rpm, ac, motors, one by steam turbine
Hydraulic couplings on draft fans.....American Blower Corp

Feedwater system:

Deaerating heater.....Cochrane Corp
Fitted with vent condenser, 200 sq ft condensing surface
Closed heater, 4-pass condenser type, 525 lb press.....Alco Products Co
Blowdown heat exchanger, shell-and-U-tube....Ross Heater & Mfg Co
Evaporators, 3-stage, horizontal.....Foster Wheeler Co
Boiler-feed pumps, four, 500-gpm, 1227-ft head.....Ingersoll-Rand Co
Three pumps driven by turbines, one by motor at 3600 rpm

Electric generating equipment:

Turbine-generators.....General Electric Co
Two 7500-kw, extraction-condensing, 3600-rpm turbines. Throttle: 425 lb, 700 F. Extraction: 25 lb. Two 3-phase, 60-cycle, 6400-volt, 0.80-pf generators with air coolers. Three 3000-kw, extraction-condensing, 2400/3000/3600-rpm turbines. Throttle: 425 lb, 700 F. Extraction: 25 lb. Three 3-phase, 120/150/180-cycle, 2760/3450/4140-volt, 0.80-pf generators with air coolers
Exciter sets, two, 50-kw each.....General Electric Co
One motor-driven, 125-volts, 400-amp; other turbine driven
Switching equipment, metal clad.....General Electric Co
Oil coolers, shell-and-tube, vertical.....General Electric Co
Oil purifiers, centrifugal separators.....De Laval Separator Co
Oil-sedimentation tank, double-compartment.....S F Bowser Co

Condensing system:

Condensers and auxiliaries.....C H Wheeler Mfg Co
Two 13,300-sq-ft, 2-pass, ¾-in. OD Admiralty tubes. Three 5700-sq-ft, 2-pass, ¾-in. OD Admiralty tubes. Three circulating-water pumps, 20,000-gpm, 50-ft head, 514-rpm, double-suction horizontal volute, driven by ac motors. Ten condensate pumps (2 per condenser): four motor-driven, 75,000-lb-per-hr, 115-ft head, 1200-rpm; six motor-driven, 35,000-lb-per-hr, 115-ft head, 1200-rpm
Desuperheater, absorption type, 75,000-lb-per-hr.....Elliott Co
From 415 lb and 700 F to 25 lb and 275 F
Desuperheater, spray type, 10,000-lb-per-hr.....Republic Flow Meters Co
From 415 lb and 700 F to 150 lb and 395 F

Instruments:

Indicating and recording pressure.....Consolidated Ashcroft Hancock Div; Bailey Meter Co
Indicating and recording temperature.....Taylor Instrument Cos; Bailey Meter Co
Draft gages.....Bailey Meter Co
Mercury-column vacuum gages.....Taylor Instrument Cos
Flowmeters, steam-flow—air-flow meters.....Bailey Meter Co
Water-level indicator and recorders.....Bailey Meter Co
Potentiometers.....Brown Instrument Co
CO_2 recording meters.....Republic Flow Meters Co

Piping and valves:

Pipe and pipe fabrication.....B F Shaw Co
Safety valves.....Consolidated Ashcroft Hancock Div
Blowoff valves.....Edward Valve & Mfg Co
Feedwater regulators, one per boiler, Copes.....Northern Equipment Co
Atmospheric-relief and pressure-reducing valves..Atwood & Morrill Co
Boiler non-return valves.....Edward Valve & Mfg Co
High-pressure steam valves.....Edward Valve & Mfg Co; Chapman Valve Co
Miscellaneous valves.....Chapman Valve Co; Edward Valve & Mfg Co; Wm Powell Valve Co

way, and flash from the last tank goes, with vapor from the last stage, into the low-pressure system.

Distilled-water pumps discharge into the surge tank shown on the main flow diagram. This feeds two open heaters hooked up in parallel with two sets of feed pumps discharging into a loop header. A single closed heater, taking steam from the 25-lb header, constitutes the second stage of feed heating. Provision has been made for chemical treatment in the drum.

All five turbine-generators are extraction-condensing. Circulating pumps take their suction from a cold well supplied from a large spray pond and a sedimentation basin. Some heat picked up from the condensers is salvaged, since part of the warm circulating water is pumped to the mill for process use. The remainder goes back to the pond.

The three high-frequency turbine-generators are unusual, although they resemble standard units on the turbine end. Different frequencies are obtained by changing the spring on the governor mechanism, thus increasing speed range of a unit. Frequencies range from 120 to 180 cycles and the machines are arranged to operate in parallel, or separately at different frequencies. Generation at desired 120, 150 or 180 cycles saves 25% loss encountered in conversion from 60 cycles, and gives greater operating flexibility.

Satisfactory experience with metal-clad switchgear at the Marcus Hook plant led to selection of the same equipment for Front Royal. A study of ultimate plant loads indicated the wisdom of making the 60-cycle-generator voltage 6400, as this meant smaller copper conductors and reduced ampere capacities of oil circuit breakers and switching equipment.

The entire switching system is interlocked mechanically, so that if two buses are not synchronized, the selector disconnecting switches cannot be closed on both buses at the same time. If the bus-tie breaker is closed, indicating that both buses are in synchronism, then the switches on various circuits, either generator or feeder, can be connected to either or both buses. This protective feature is, of course, very important in a plant where machines operate at different frequencies.

Water from pond goes to condensers; some of it, after heat pick-up, is used in process

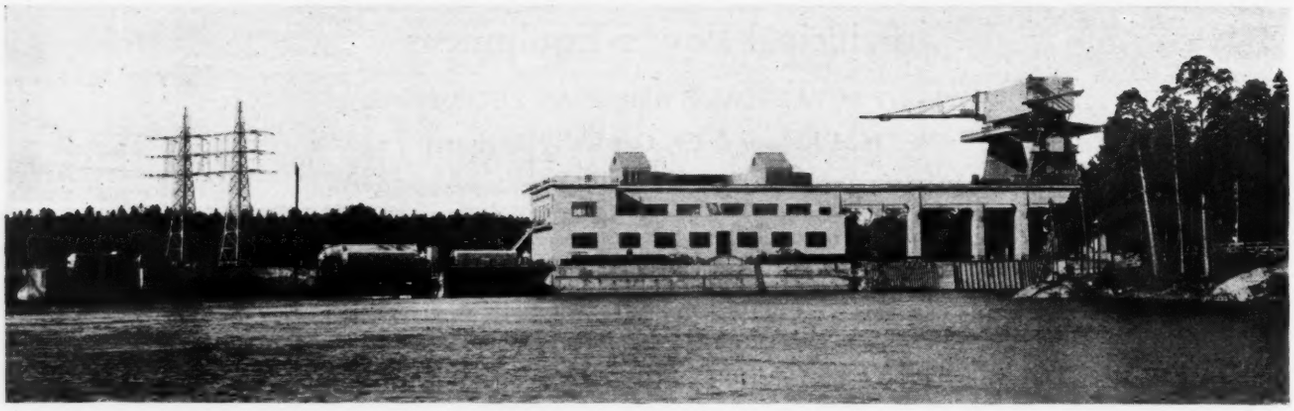


Fig. 1—Construction costs have been reduced by installing the generators outdoors and placing the turbines in syphon settings

Low Head Produces High Capacity

Two Kaplan propeller turbines, Vargön hydro plant, Sweden, develop 18,000 hp under 14-ft head, making them the highest-capacity units in the world for this head

By GEORGE WILLOCK
Trollhättan, Sweden

SWEDEN has long been a leading user of hydro power and many of its water-power plants are outstanding. Newest and most notable is the Vargön Station, with the extremely low head of 11.5 to 16.5 ft and two 18,000-hp Kaplan turbines. This plant, at the head of the Gotha River, where it leaves Lake Vänern, is 50 miles from the city of Gothenburg at sea level. Below Vargön are the Trollhättan plant operating under a head of 105 ft and Lilla Edit with a head of 21.5 ft, all owned and operated by the Royal Board of Waterfalls of Sweden.

Turbine Runners

The turbine runners at Vargön are 26.25 ft in diameter, the largest in the world. Because of the low head, it probably would not have been economical to develop this site but for the fact that the dam had to be built to control flow from Lake Vänern. Putting a power plant into this dam did not materially increase its cost, because expense was kept low by placing turbine runners above headwater level in syphon settings, making head gates unnecessary and greatly reducing the amount of rock excavation for the draft tubes. Building costs were also reduced by placing the generators outdoors, protected by plate-steel housings.

Lake Vänern is Sweden's largest and Europe's third-ranking in size. With 5.5-ft draw-down, it stores sufficient water to generate 850,000,000 kwhr, which is about 60% of that generated in the three plants on the Gotha River.

Between the power house, at one end of the dam, and the other bank are four openings in the dam, three of which are closed by sector gates 43 ft long. The fourth opening is closed by

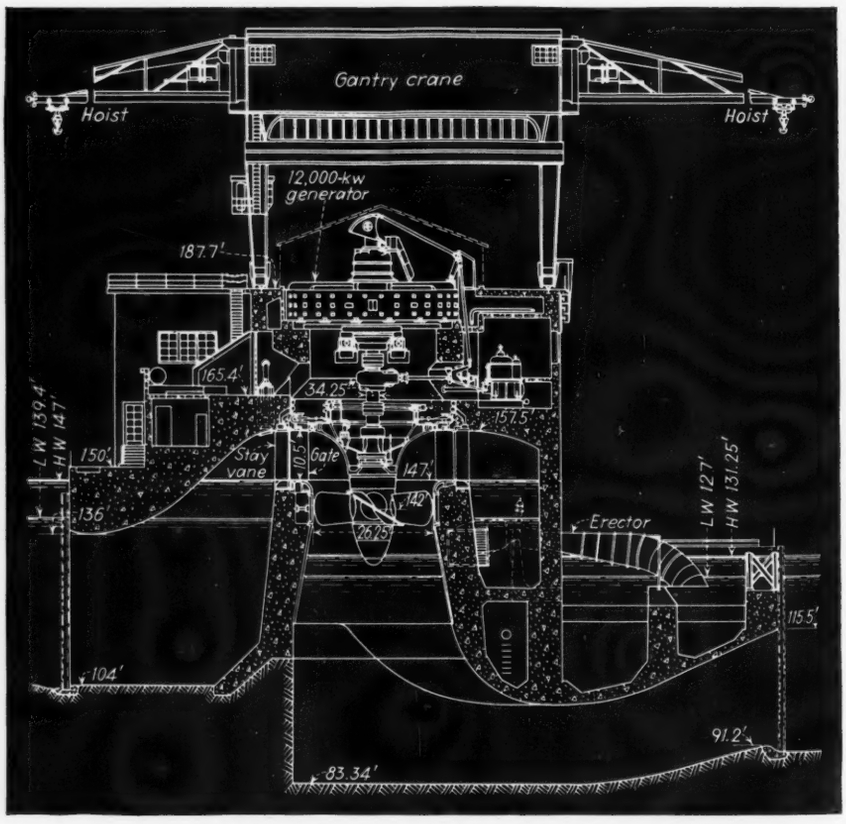


Fig. 2—Cross-section through power house showing turbine in syphon setting

an ordinary sluice gate. Two of the sector gates can be controlled from the Trollhättan plant 12 miles downstream.

Fig. 2 shows a cross-section through the power house and one of the units, with its syphon setting. Because of the large volume of water required by these units, water passages are enormous. Intake openings to each unit are 62.5 ft wide by 32 ft high. Measured from the center line of the runners, the draft tubes have a depth of 59 ft and their outlets are 67.5 ft wide by 24.3 ft high.

Each runner of the Kaplan propeller turbines has four stainless steel blades, which are adjusted by a governor-operated servomotor to an angle corresponding to head and the load on the unit.

Crown plate and gate rings of each unit are cast-iron segments bolted together. Weight above the syphon is carried down into the draft tube and foundation by 12 stay vanes. A plate-steel lining extends down into each tube for 28 ft from its top. Chrome-nickel plates are used in the top half of these linings and mild-steel plates in the bottom half. Linings are made in segments and bolted together, one of which can be taken out for removal of the runner blades.

Twenty-four gates, 10 ft 6 in. long, under the control of the governor, regulate water flow to each unit. Gates on unit No. 1 are vertical and are positioned by a single servomotor. On unit No. 2 gates are at an angle, Fig. 3, and are operated by two servomotors. Each governor has a capacity of 440,000 ftlb.

Turbine Shafts and Seals

The 34.25-in. diameter turbine shafts run in white-metal, force-oil-lubricated bearings bolted to the crown plate. A labyrinth water seal where the shaft passes through the crown plate, Fig. 3, prevents air leaking into the syphon chamber, where pressure is below atmospheric.

Naturally, in a plant of this unusual design, control is a feature. Each actuator is driven by a synchronous-reaction motor. A synchronous generator, driven from the main shaft by the same gearing that drives the exciter and the governor pressure-oil pump, supplies current to the motor. When turbine speed varies, the actuator admits pressure oil to the servomotor, which opens or closes the gates to bring speed under control. Simultaneously, pressure oil is admitted to the servomotor controlling runner-blade pitch, which positions the blades for the new gate opening.

As turbine gates are above headwater level, the flume must be filled with water before the unit can be started. Filling of the flume is done by evacuating air from it by a large ejector, which requires about 4 hours. A small ejector is arranged to come into service automatically if water level in the syphon starts to drop. This ejector is actuated by a contact on the float-operated rheostat that indicates water level in the turbine chamber. It has been found that any air collecting in the top of the syphon, when the turbine is running, is carried down through it with the water, making unnecessary use of the small ejector.

Two air valves on the top of the syphon, held closed by governor oil pressure, can be opened and closed from the turbine-control panel. When these valves are opened, which is done only in an emergency, the vacuum is destroyed and the syphon empties of water in a few seconds. This is done in emergency only, because it requires 4 hours to evacuate the flumes and get the unit running again.

In starting, the runner blades must be in full-load position, which is just the opposite of blade position when the gates are closed. This is taken care of by a cam in the combinator, a mechanism that combines movement of

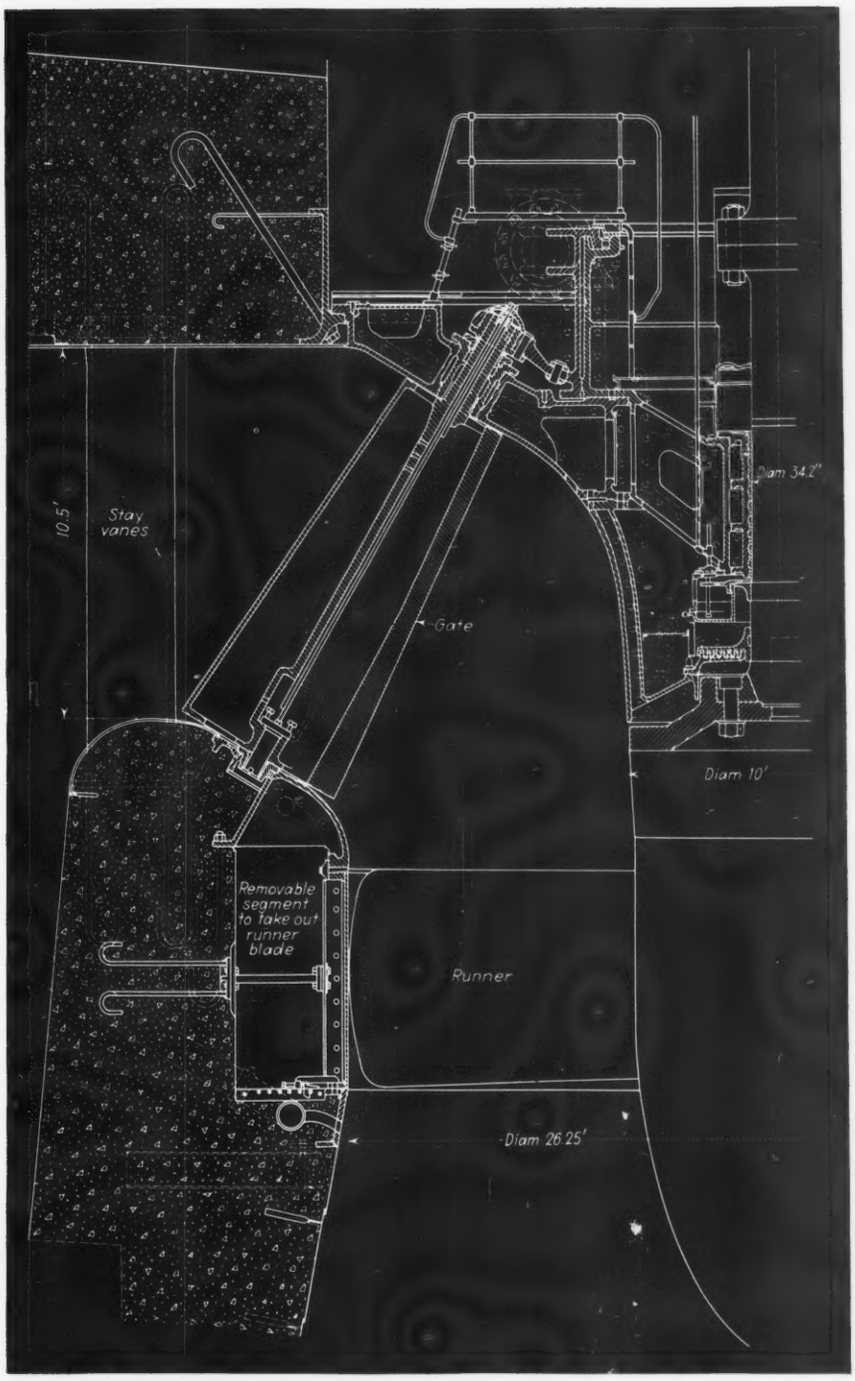


Fig. 3—Partial cross-section through No. 2 turbine. Gates are at an oblique angle

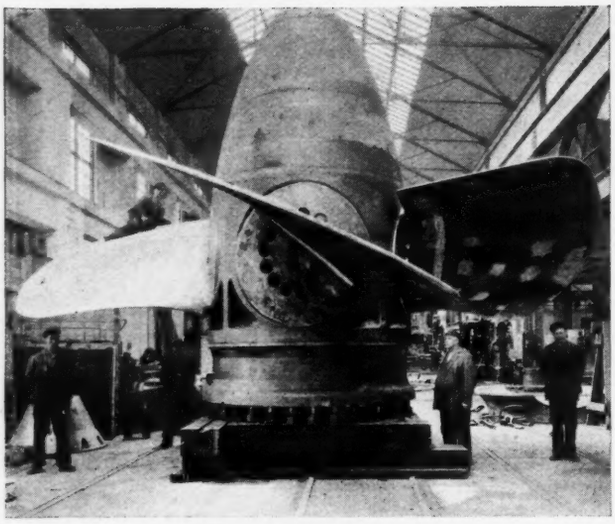


Fig. 4—Runners for the Vargön turbines have 4 stainless-steel blades and are a record-breaking 26.25 ft in diameter

Fig. 5—Outdoor generators at Vargön plant are 38 ft outside diameter, protected by plate-steel housings

runner blades with that of the gates. When the gates are opened slightly more than required for no-load running, the turbine starts. Then, the combinator motor goes into action, moving the runner blades to their normal position. This position is indicated on the control board by signal lamps.

Stopping a Turbine

To stop the turbine, the gates are closed and held by a catch, after which the combinator motor turns the runner blades to the open position ready for starting. Operation of the combinator motor is interlocked with the catch on the gates to prevent incorrect sequence of operation.

If a turbine is in operation and oil pressure in the receiver falls below a given value, oil supply to the blade servometer is cut off and a valve opens to the servomotor on the gates to close them. The servomotor operating the blades requires so much oil, that in emergencies the oil supply is cut off to insure sufficient oil to close the gates.

Since governor actuators are motor driven by power from their own generators, the most likely source of trouble here is generator field failure or a short circuit in the wiring between generator and actuator motor. To avoid any trouble from this source, three voltage relays are connected to the generator terminals. These relays go into the circuit at a predetermined interval after the gates open and stay connected as long as gates are open beyond no-load position. If power to the governor motor fails, one or more of the voltage relays close contacts and energize a magnet that locks the gates for whatever load they are set. At the same time, the protective device at fault is indicated on the main control board. When the fault is removed, the gates can be unlocked by a pushbutton on the turbine-control panel.

A centrifugal switch on the exciter shaft protects against overspeeding. If turbine speed gets out of control of the governor, the overspeed switch energizes a magnet that causes the gates to close. Should this protection fail, then the unit is stopped by opening the vacuum-breaker valves. These valves are normally held closed by governor pressure oil, but open automatically if oil pressure falls below a value that will operate the gates. These valves can be relied upon to stop the unit in all cases of emergency, because when they open, water ceases to flow to the turbine.

Overvoltage Control

Another centrifugal switch on the exciter shaft opens the exciter-field circuit in case of overspeed. This prevents overvoltage on the main generator and overloading of the exciter. When the gates are closed by the overspeed magnet or by opening of the air valves, the generator circuit breaker and exciter switch open automatically.

Each turbine drives a 12,000-kva, 11,000-volt generator. No. 1 is 25 cycles, No. 2 50 cycles. Because of their low speed, 46.9 rpm, the generators have very large dimensions for their capacity—38 ft outside diameter. A thrust bearing below the rotor has a load capacity of 1,600,000 lb. Power from both generators is transmitted to Trollhättan and there connects into the 25- and the 50-cycle systems.

Since the Vargön plant acts as a flow regulator from Lake Vänern, it is considered a part of Trollhättan station and is therefore remotely controlled from it. Normally, Trollhättan controls Vargön and is equipped with all the necessary control and indicating devices for doing this, with the exception of starting and synchronizing the machines. This has to be done by operators at Vargön.

Remote control from Trollhättan includes operation and supervision of the generator breaker position; also takes in supervisory control of transformer-voltage-ratio regulator, two sector gates, turbine-gate opening, governor-operating range and voltage-regulator setting for each unit. Meters at Trollhättan show water level in the turbine flumes, head- and tail-water levels, turbine-gate opening, governor position, voltage, frequency, kw load and the kwhr generated at Vargön. Alarm signals are transmitted to Trollhättan when water level is low in the turbine flumes and when temperature of the generating windings exceeds a safe limit. Control of Vargön is so arranged that it can be transferred to either plant.

Fire Protection

Differential relay protection on the generators disconnects them, closes the turbine gates and floods the generator windings with carbon-dioxide gas to extinguish any fire that might develop from a winding fault.

Turbine and governor equipment were built by Karlstads Mekaniska Verkstads Aktiebolag, Karlstad; and Nydqvist & Holm AB, Trollhättan, both runners being built by the first mentioned company. Generators and all electrical equipment, also gantry crane, were supplied by The ASEA Electric Co Ltd, Västeras and the sector gates by Nydqvist & Holm AB. The Royal Board of Water Falls designed and built the plant.

Pumps Act Like People

Both change their actions to suit conditions. Here are answers, with performance curves and hookups, on what to expect when you switch operating environment on centrifugal pumps

By FRANK A KRISTAL
Mechanical Engineer, New York, N. Y.

PERFORMANCE of centrifugal pumps follows definite laws. For example, capacity and head depends upon speed, impeller diameter and width. At constant speed, capacity decreases as head increases with reduction in power input. As head goes down, capacity and power input increase. Capacity varies as the speed, head varies as speed squared and power input as the cube of the speed. Capacity also varies as impeller diameter. Head varies as diameter of impeller squared and power input varies as impeller diameter cubed.

The characteristic curves for any pump give a picture, in simple graphical form, what will happen under any specified conditions. A set of these curves usually includes capacity-head relation, efficiency, and horsepower input to the pump shaft. Fig. 1 is a typical set of characteristic curves for a 4-in. pump.

Data for plotting these curves for any pump are found by testing the pump through its complete range of capacity from maximum to shut-off, at a constant speed. The data may also be estimated from performance tests of a similar pump under equivalent conditions. During test, the capacity, head and the brake-horsepower are usually read directly, and the efficiency then calculated from the formula:

$$Efficiency = \frac{GPM \times Head\ (in\ feet)}{3960 \times BHP}$$

Capacity is measured by a Venturi meter, weirs, calibrated nozzles, or other accurate method. At the suction and discharge nozzles of the pump, pressure gages measure the head. Brake-hp is obtained by a torsion dynamometer, or by means of a calibrated motor.

The characteristic curves, Fig. 1, show that the pump is suitable for 300 gpm against a total dynamic head of 100 ft at 1750 rpm. At this rating pump efficiency is 70%, and 11 hp is required to drive it. This pump is efficient over a range of capacity from 275 to 400 gpm for heads of 103 to 82 ft. If the head where the pump is installed differs slightly from rated, the pump will still operate satisfactorily. If the operating head is 95 instead of 100 ft, pump capacity will increase to 340 gpm without overloading the 15-hp driving motor.

Increasing or decreasing pump speed raises or lowers the capacity curve. Capacity varies directly with speed, and head varies as speed squared. Thus, if the pump, Fig. 1, turns at 2000 rpm, instead of 1750, its capacity would increase from 300 to $(2000 \div 1750) \times 300 = 343$ gpm, and the head would rise from 100 ft to $(2000 \div 1750)^2 \times 100 = 131$ ft, approximately. The dotted curve, Fig. 1, shows the head-capacity curve at 2000 rpm. If we assume that the efficiency curve remains approximately the same for both speeds, then the efficiency at the new capacity will be about 71%, but the power to drive the pump increases to:

$$\frac{GPM \times Head}{3960 \times Eff.} = \frac{343 \times 131}{3960 \times 0.71} = 15.9\ hp.$$

If efficiency remains constant, power input to the pump will vary as the square of the speed.

Capacity of a centrifugal pump varies directly with impeller diameter, and head varies as the square of im-

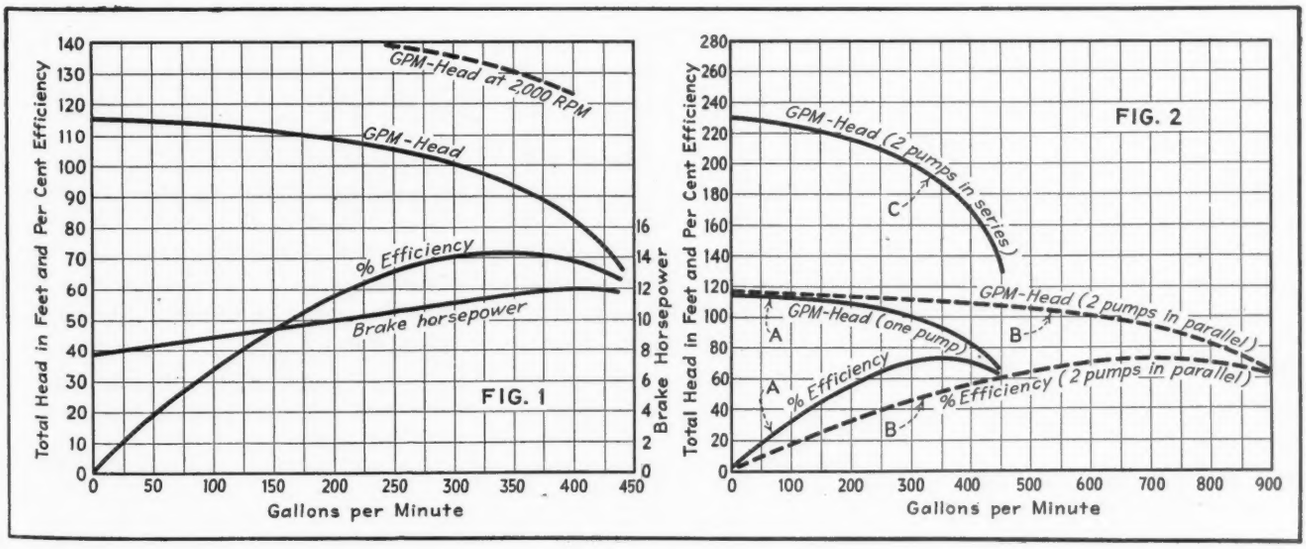


Fig. 1—Characteristic curves of a 4-in. centrifugal pump, good for 300 gpm at 100-ft head. Fig. 2—Performance curves of two pumps, same type as shown in Fig. 1, connected in parallel, Curve B, and in series, curve C

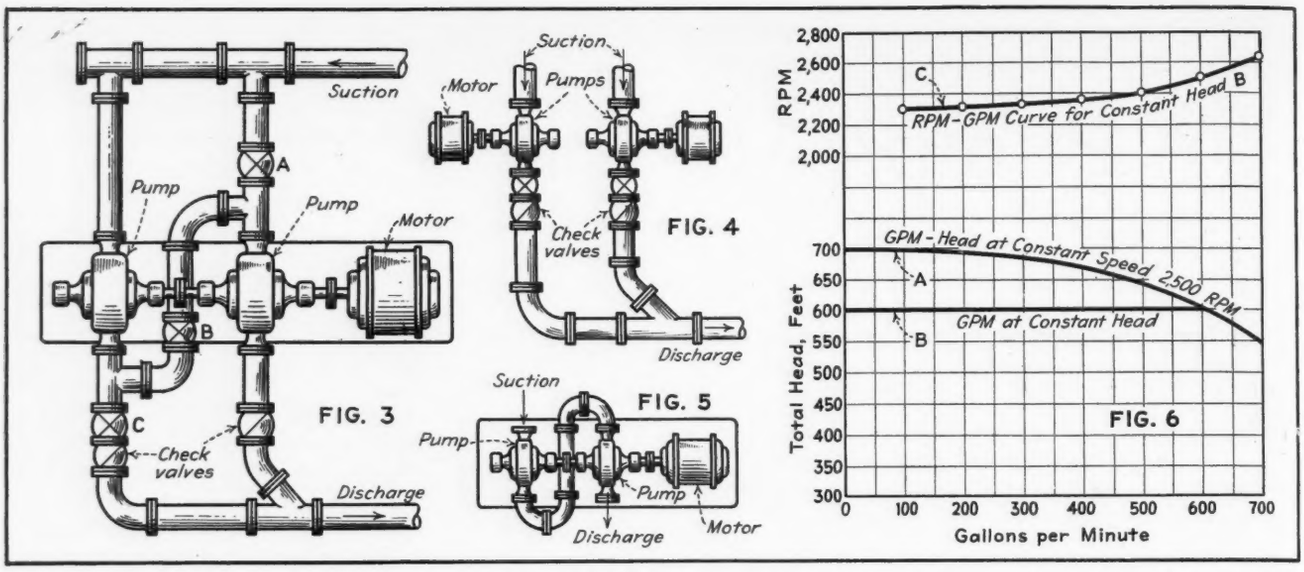


Fig. 3—Two centrifugal pumps arranged to operate in either series or parallel. Fig. 4—Two centrifugals in parallel. Fig. 5—Two centrifugals in series. Fig. 6—Curve C *shows speed necessary to maintain constant discharge head at different rates of flow*

peller diameter. For the conditions, Fig. 1, assume an impeller diameter of 10-in., which is very close to the actual. If the impeller diameter were reduced to 9-in., the pump would then be good for 81-ft head.

When two centrifugal pumps are operated in parallel, a valve is put in the discharge of each so that either or both can be operated and controlled satisfactorily. If one pump is running and the other is to be put into service, bring the latter up to full speed and pressure before opening its discharge valve. Since pressure developed by the pump against the closed valve, usually known as the shut-off head, is higher than normal operating pressure, the pump will operate against line pressure.

Curves *A*, Fig. 2, are for a single pump; curves *B* indicate operation of two pumps of equal rating in parallel. The capacity indicated at any point on the gpm-head curve is twice that for the single pump operating under the same head.

The head loss due to pipe friction increases approximately as the square of the liquid velocity in the pipe. Doubling the flow increases the head losses four times in the pipe. For example, assume that the 100-ft head on the single pump was made up of 95-ft static and 5-ft pipe and fittings losses. Now, if we double the flow in the pipeline, we still have the 95 static head, but the pipe and fittings losses increase to $5 \times 4 = 20$-ft head, making the total head $95 + 20 = 115$ ft. The pumps cannot discharge their rated capacity against this head so they drop to a lower discharge rate. Of course, this condition can be corrected by making the pipe large enough so that the two pumps can deliver their rated capacity at rated head. When this is done, one pump operating alone will deliver more than its rated capacity.

Pumps in Parallel

When two pumps operate in parallel and discharge into the same line, as in Fig. 4, it is essential that their motors have practically the same speed characteristic so that neither pump develops a higher pressure than the other. Where dc motors are used, it is advisable to select the compound-wound type. Put check valves in the discharge line from each pump, to prevent either building up backpressure that would make operation of the other unsatisfactory.

Two pumps can be installed for series operation to discharge against double the head of one pump and the same capacity. Fig. 5 shows two single-stage pumps in series. Curve *C*, Fig. 2, gives head-capacity for this arrangement. It is constructed by plotting double the head of one pump against its discharge under the given head conditions. For example, in Fig. 2, the pump is good for 100 gpm at 112-ft head. Two of the pumps in series will discharge 100 gpm against $112 \times 2 = 224$-ft head, as shown by curve *C*.

Efficiency of two pumps operating in parallel or in series is practically the same as for one pump alone. The installation can be arranged with a single motor for the two pumps, or with a separate motor on each pump. Sometimes, a pumping installation is designed for one capacity against a high head or approximately twice the capacity against half the head, Fig. 3. For parallel operation, valve *B* is closed, *A* and *C* opened. When series operation is needed, valve *B* is opened, *A* and *C* closed.

WATCH FOR THE BUYER'S GUIDE ISSUE
Coming in Mid-December,
A FOUR-PART HANDBOOK FOR 1940

1. **Buyer's Guide—Where and What to Buy**
2. **New Equipment Review**
3. **Review of New Bulletins and Catalogs**
4. **ASME Annual Meeting Report**

What is it? In brief, an up-to-the-minute reference guide to who sells what today, latest equipment, most recent engineering literature, most modern engineering thinking.

Why are we doing it? Loads are growing, wheels turning faster, plants modernizing. Power men everywhere are seeking latest facts and ideas, new dependable sources of supply to supplement inadequate catalog files. Here is quick help.

What will it do? Give you in one binding the road map for engineering action.

And, remember, this is a reference book for the whole of 1940, to be used again and again. File it handy to your working desk, at the plant.

More Steam From Less Boiler

One by one—La Mont, Benson, Loeffler, Velox—the radical innovations in boiler design come out of Europe. American engineers watch the parade with mixed reactions. There is unstinted admiration for technical skill and ingenuity, and full appreciation of the advantages gained. But with these feelings goes a certain natural bewilderment—why forced circulation, pressure combustion, extreme compactness and light weight, when apparently purchased at the expense of simplicity and reliability?

Advances in design don't just happen. There are good reasons behind the European drive for "maximum steam from minimum boiler," just as there were good reasons behind American pioneering in power units of giant size. But reading of foreign developments as they are reported in the technical press fails to disclose these reasons. We get isolated facts, without background or interpretation.

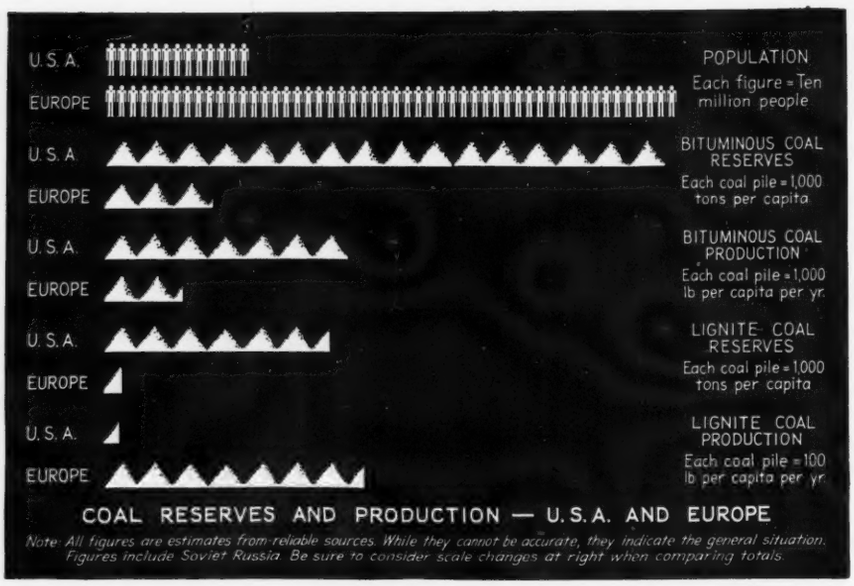
Make no mistake—we need a complete picture of European boiler development. Conditions force designers abroad to take vast strides, some in the right direction, some probably wrong from our point of view. But whether or not these developments are economically or technically desirable for us today, those that have stood the test of time must be looked on as steps toward the ultimate boiler. Considered in this light, these modern European designs outline the "shape of things to come" as far as boiler practice in this country is concerned.

To know what's ahead in boiler engineering, the busy man should have a summary that will stack these new designs side by side so he can see what makes them tick, compare them, check their performance records. Above all he wants a summary that tells *why* the development took the shape it did. The facts are available, in print, but scattered through hundreds of engineering-society papers, technical-magazine articles and reports, many of them in foreign languages. The busy engineer wants this material digested and interpreted, wrapped up in a handy package for easy reference.

Spotting this need about a year ago, POWER's editors commissioned Max F A Wulfinghoff to gather material. Wide contacts with leading European engineers and manufacturing organizations made it possible to assemble a mass of data, some of it previously unpublished. Luckily, the work got under way early in 1939; otherwise war censorship and the general breakdown of international engineering contacts would have made completion difficult.

The survey that follows does three basic jobs: it gives the background of the European designs, tracing the forces that produced them; it presents a condensed summary of each of the leading types, showing basic features, listing advantages and disadvantages, discussing performance and picturing extent of use; and finally it gives a comprehensive bibliography of material, in English and foreign languages, for the engineer who wants details beyond the scope of this presentation. POWER believes this to be the first time this three-fold job has been done, in English, and it is our hope that it will prove both useful and stimulating.

Reasons Why—



COAL RESERVES AND PRODUCTION — U. S. A. AND EUROPE

Note: All figures are estimates from reliable sources. While they cannot be accurate, they indicate the general situation. Figures include Soviet Russia. Be sure to consider scale changes at right when comparing totals.

AS MIGHT BE EXPECTED, boiler engineering abroad is roughly parallel to ours in many ways; the trend to high pressures and temperatures, increased outputs and rational design is universal. Operating pressures in Europe are now up to 3000 lb, depending, of course, on individual power and process requirements. Boiler output has risen to 160 tons per hr; usual sizes range between 25 and 50 tons. Natural-circulation boilers are still in the majority, but the proportion of boilers with artificial circulation is growing, now running close to 25%.

In spite of the similarities, it is the radical departures from conventional design that interest American engineers, that bring into sharp focus the different conditions faced by designers abroad. What are these special conditions and how are they met?

American Practice

First, let's take a look at our own boilers. Designers have aimed at meeting demands for larger and more flexible units, with reliability and availability as important considerations. With both materials and fuels relatively cheap, emphasis naturally is on making boilers that can be guaranteed to work. This means that existing basic designs are made larger, drums are made thicker for higher pressures, and changes are made step by step. Reinforcing this attitude is the fact that for many years the trend in American central-station design has been towards larger installations, with one or two boilers per turbine.

In almost every respect, conditions in Europe are reversed. In the first place, individual countries are smaller, which means smaller power networks and smaller generating stations. Also, the small plant can better utilize waste heat in district heating or process work.

Preparedness for emergencies has been proven a valuable asset "over there." European public-utility systems are closely interconnected and this decentralized operation lessens the importance, to the system as a whole, of damage to individual plants from storms, strikes, sabotage or air raids. Recent laws make cooperation between power plants even more compulsory.

All this points to smaller turbines and, particularly where several boilers serve each prime mover, to smaller boilers. Add the fact that energy for auxiliaries is readily available from interconnected systems, and the importance of individual-unit reliability goes down, permitting free experimentation with design.

Cost and supply of fuel is another basic difference. Most American plants are built to handle relatively good grades of coal or other high-quality fuels, and there is not, as yet, any strong economic incentive to save the last ounce of fuel. In Europe, especially on the continent, prices are high, amount of fuel available is definitely limited, and quality varies widely. The chart gives the picture for coal; conditions are actually somewhat worse because of the very uneven distribution of these resources. Europe is, of course, notoriously petroleum-poor, but lack of statistics makes it impossible to give an accurate numerical picture.

Byproducts from Coal

The important role now played by products obtainable from coal acts to further upset the picture. Coal is treated by carbonization, or other methods, to yield light oils, hydrocarbon gases, tars and coke, which constitute a secondary source of fuel. The net effect is to make the internal-combustion engine, indirectly, a customer for coal, increasing the total demand and boosting the price.

Conditions abroad thus put a premium on fuel economy and ability to burn coals of varying qualities, mostly bad compared with typical American fuels.

Perhaps most important of all differences affecting design here and abroad is the relative importance of materials and labor. For America, the situation is aptly summed up by Alfred R Smith, writing in *Combustion*, February, 1939: "The employment of greater quantities of materials (in a given boiler) is sound . . . because much of the iron returns to commerce as scrap . . . the sum of the cost of material and labor is the true criterion for judgment."

Economic Factors

European designers have discarded the idea that minimum total expense for labor and materials must be attained. They try to avoid buying from foreign countries, to lessen the strain on their country's exchange systems, and they regard any increase in wages as a community investment. Thus, manufacturers abroad attempt to make the best possible use of native materials and at the same time to provide employment for the sake of "the social order."

Although these reasons stem largely from nationalistic political creeds, it shouldn't be overlooked that backing them up are hard economic realities—scarcity of important engineering materials and generally lower wage scales. These factors not only force radical solutions to engineering problems (radical, that is, from our point of view), but tend to create an experimental attitude on the part of the user. The operator is willing to nurse along relatively untried equipment because the economic rewards are high.

Thus the European stage is set for any design that promises more performance from less boiler.

Logic Shaped the "Super" Boiler

WITH MAXIMUM PERFORMANCE from minimum equipment as a common goal, European designers follow two general lines of attack: some concentrate on refinement and improvement of conventional types while others strike out in new and relatively untried directions. A clearer picture of the entire development can be gained by looking first at efforts along the former line, since limitations encountered in this direction reveal some of the reasons behind the radical departures.

Before going ahead, however, it would be a good idea to clear up the relation between the general trend to higher pressures in power plants and specific trends in boiler design. Raising pressure improves central-station cycle efficiency and may contribute to an all-around smaller, lighter, and less costly plant. Likewise, industrial plants go to higher pressures to secure maximum byproduct power from necessary steam generation.

Demand for boilers to operate satisfactorily at higher pressures produced some special designs (Loeffler, Schmidt-Hartmann) aimed at overcoming the difficulties introduced. However, other designs (Velox, La Mont) bear no definite relation to high-pressure problems; the makers set out to produce boilers of high specific output and desirable characteristics, boilers suitable for any pressure range.

To get back to conventional natural-circulation boilers: the European trend is to clear-cut designs, with well-defined steam circulation and a generous number of cold downcomers. Research has helped to eliminate defects caused by faulty circulation in the main circuit; waterwalls and headers are still under investigation. In general, medium-size and large boilers follow similar patterns.

A major tendency of European design is to increase the proportion of radiant heating surface. Radiant heating, of course, takes place at higher heat-transfer rates and so less surface is required. Radiant tubes can be conveniently grouped around furnace walls, eliminating need for refractory and producing a compact unit.

Smaller, Fewer Drums

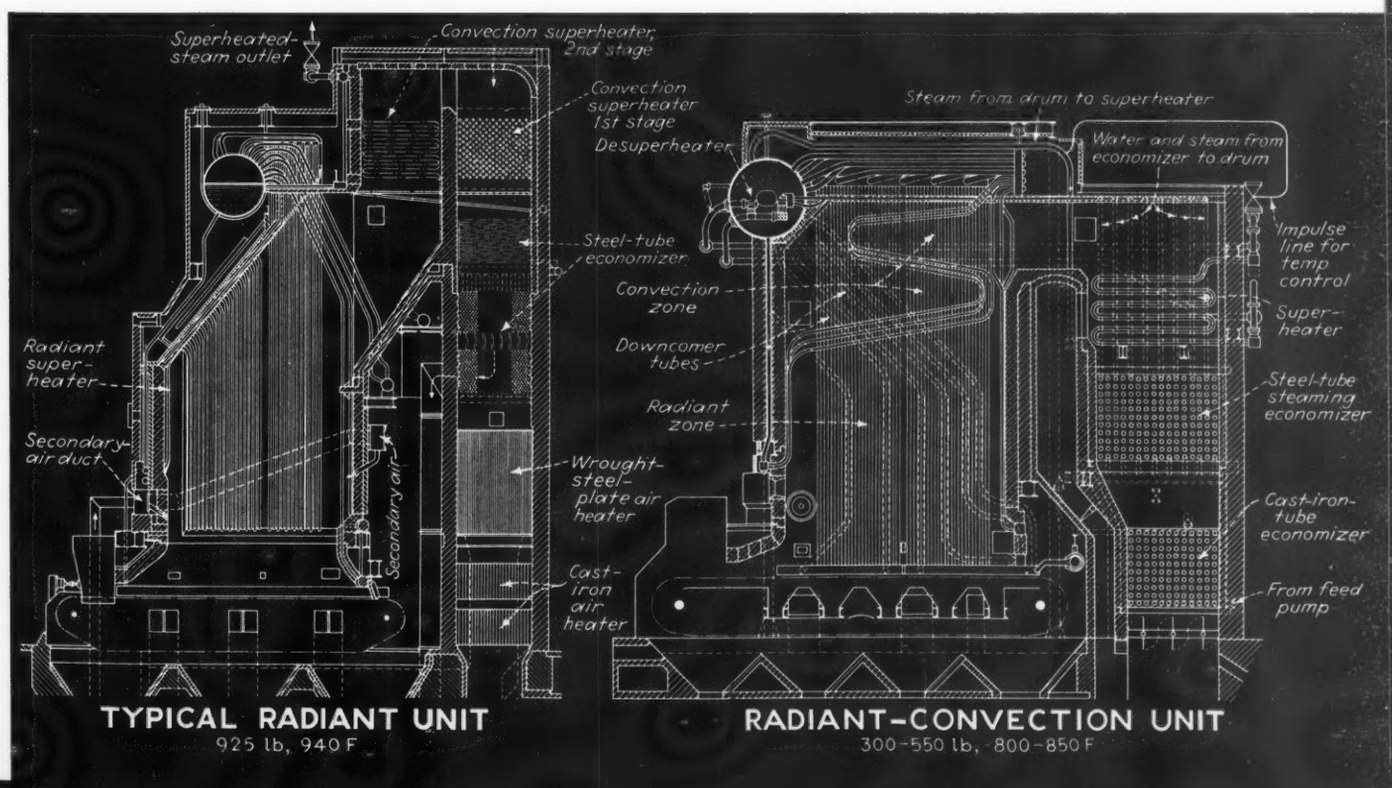
A parallel trend is towards smaller and fewer drums, logically leading to replacement with collectors. This naturally ties in with the increased use of radiant surface, since radiant tubes grouped around the furnace can best be connected by headers or collectors. "Drumless" units sacrifice reserve but new methods of heat storage and transformation overcome this difficulty in plants with heavy load fluctuations.

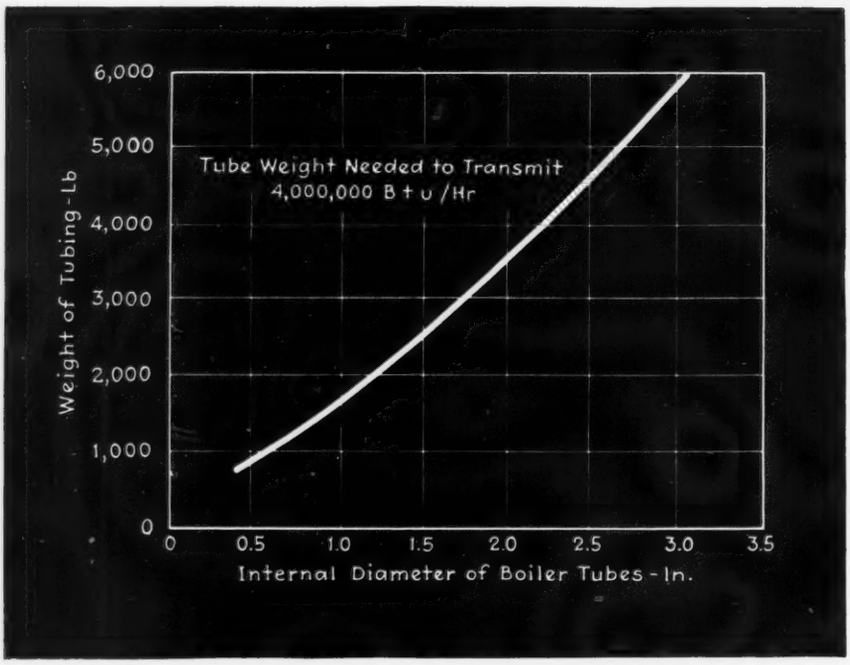
The savings from fewer and smaller drums are greatest in high-pressure boilers, where the thick-walled drums are a major item of cost. In the middle pressure range, where the economic advantages of the radiant "drumless" design are less, compromise units combining a radiant tube system with a one- or two-drum convection system give good results. This arrangement may permit dispensing with an economizer. Boilers so designed are compact and have simple gas passages. The final price is low, because less brickwork and steel construction are needed.

Typical of modern European practice in the natural-circulation field are the two units illustrated. The single-drum unit at the left, equipped with a standard traveling grate, is designed to operate at 925 lb and 940 F with maximum continuous output of 120,000 lb per hr. Practically all heating surface is radiant; the convection surface comprises only four tube rows, of which two in front serve to shield the rear furnace wall against excessive heat. The drum and downcomer tubes are protected against external heat. A part of the superheater lies in the radiant zone, helping to keep the front-wall temperature low.

The other unit represents a development of the classic B & W cross-drum type. The S-shaped tubes receive heat by radiation and convection on practically their entire length. The method of suspension of these tubes produces extreme flexibility. The S tubes, as well as the rear-wall tubes, connect to vertical headers, while lateral radiant tubes run into horizontal collectors which in turn connect to the vertical headers from which the steam passes to the drum.

This boiler has a steaming economizer; these find increasing favor in Europe today. The unit also has a cast-





iron gilled-tube pre-economizer and a plate air heater. The superheater lies in the second gas pass and is arranged in countercurrent. A desuperheater in the boiler drum controls final steam temperature; this is fairly common practice in Europe. This boiler type is used for pressures from 300 to 550 lb, at steam temperatures of 800—850 F.

Increasing application of aerodynamic design to gas passages of European boilers saves fan power. For this reason, single-pass boilers have gained in popularity in spite of greater headroom needs. Half the draft loss in multipass water-tube boilers results from directional changes and complicated ductwork. This draft loss usually limits gas velocity to 35-40 fps. In special boilers, to cover peak loads of short duration, velocities up to 400 fps are being tried.

Here we see one of the problems facing the designer looking for maximum output from minimum boiler: to what extent should materials be replaced by energy? More powerful auxiliaries, such as fans, consume more energy and require larger motors and switchgear. In this matter of auxiliary power, K Schroeder states that in Europe today the best balance seems to be struck when the energy consumption of the boiler plant amounts to 6-7% of the power generated by the boiler.

In line with the tendency to look critically at the weight and cost of material used in boiler construction, F Merx has calculated the total weight of tubing needed to transmit approximately 4,000,000 Btu per hr, using tubes of different diameters. His chart (above) shows a clear advantage for smaller tubes. This gain springs from several sources: (1) smaller diameters allow thinner walls for a given pressure, and (2) as the heat transmission rate is better with small tubes than with large ones, all other things being equal, less total surface produces greater steaming capacity. Additional advantages of small-bore tubes, not included in the calculations for the chart, are better disposition of tubes in space available, because of smaller bending radii, and easier handling.

Natural vs Forced Circulation

By eliminating heated downcomers, and providing multiple downcomers to insure correct circulation under all conditions, natural circulation can be successfully applied to pressures in the range 1200-1800 lb. But for higher pressures, where circulatory forces are no longer dependable, and for tubes below, say, ½ in. diameter, natural circulation alone seems inadequate, in the opinion of European designers.

In this connection, an interesting proposal has been mentioned by Ter Linden, Dutch engineer. He suggests arranging the water spaces or drums at an unusual height, say around a chimney at about 100-150 ft from the ground, to provide the force necessary to overcome the frictional resistance of a small-bore tube system. This "reinforced-circulation" boiler combines the advantages of small tubes with the simplicity of natural circulation.

European designers, however, find that some form of forced circulation is essential to the "super-performance" boiler. This is not a new idea; an American engineer built forced-circulation boilers before the present generation of designers was born. In the past two decades, Europeans have turned to this method as a partial solution of their problem, and forced circulation is a feature of many modern designs. Its use means that small tubes, with all their advantages, can be employed; it means that tubes can be arranged to suit the space available, without worry over improper circulation. And it also means a higher rate of heat transfer. All these gains add up to a lighter, more compact boiler. Against forced-circulation are the added complication and the pumping power required.

Reduction or elimination of drums saves both weight and cost. Other forceful arguments for doing away with drums include time required for fabrication and extra weight on steel supports. Depending on the operating pressure, drums alone are responsible for from 15 to 20% of the entire boiler weight. For forged drums, the ratio between the gross weight of the rough forging block and the finished drum may be 2.5 to 1, which means a 150% waste of material. For this reason, welded drums are usual for pressures up to 1200 lb.

"Once-Through" Boilers

Even the so called "drumless" boilers have headers, collectors or other spaces with a water level for steam and water separation. Mark Benson, in the early 20's, proposed a completely drumless boiler to operate at the "critical pressure", that point where the change from water to steam absorbs no latent heat and involves no sudden increase of volume or any ebullition. His boiler, in essence, was nothing but a long tube coiled around the furnace, receiving feedwater at one end and discharging steam at the other.

Siemens-Schuckert Werke, early licensees, found that operation at critical pressure was unnecessary, that the ebullition could be handled in the tube provided the transition took place in a relatively low-temperature zone. Since then several other types of "series" or "once-through" boilers have been developed for operation at any desired pressure. Benson and Sulzer "once-through" boilers will be described in more detail in following pages; the Ramsin unit, a Russian design, closely resembles the Benson.

Where drums can be eliminated, the factor of safety is doubtless increased. In modern drumless, small-tube, high-pressure designs, the specific stresses in the tube walls are less than those in standard moderate-pressure types. Even at highest pressures, tube failures

are revealed only by a characteristic sound and by the behavior of the indicating instruments.

Drumless designs introduce new problems, however. Water reserve is low. In conventional designs the drum forms a convenient point for feed treatment and for removal of dissolved solids. Designers of "once-through" boilers show ingenuity in devising means for removing solids, as a glance at some of the specific boiler types described later will indicate.

In many conventional types and forced-circulation designs, maximum use is made of radiant surface. However, a parallel effort has led to improved designs based largely on convection heat transfer. Here the central aim is to increase the rate of gas flow past the heating surfaces. The problems involved, particularly that of balancing fan power against savings in heating surface, were mentioned in a previous paragraph. In at least three cases, engineers cut loose completely from conventional design to secure maximum convection transfer.

Both the Huettner and Vorkauf units solve the problem by rotating the boiler so that heating surfaces move through the gas stream at high rates of speed (see POWER, Sept 1939, and Nov 1932, for descriptions). These units employ natural circulation on the water side. Neither has yet been applied commercially, although experimental units have been operated.

Pressure Combustion

To get maximum convection transfer, the Velox boiler carries a pressure of about 35 lb in the combustion chamber, maintained by an exhaust-gas-turbine-driven air compressor. With this is combined forced water circulation. The gas-turbine-powered compressor makes it economical to boost gas velocities to about 700-1200 fps, producing heat transfer rates of 100 Btu per sq ft per hr per deg F. Pressure combustion makes possible heat releases of the order of 800,000 to 1,000,000 Btu per cu ft per hr, and extremely low excess air. All these contribute to high specific output and high efficiency.

To make the foregoing boiler developments practical took all the recent progress in allied fields—materials, feedwater, and control. Thus for pressures and temperatures above 1400 lb and 800 F, new materials have become available. In studying their properties, vibrational and changing-load tests are gaining in importance. Improvements in welding technique play an important part; tube connections in the boiler proper, and in the superheater, are practically all welded, even in superpressure jobs. The alloy steels required for high-temperature work can now be welded without difficulty, even in the field.

Whether natural or forced-circulation, virtually all European high-pressure boilers are now fed condensate and distillate exclusively. Even small stations concentrate on securing satisfactory feedwater; evaporators, often double-effect, are widely used. Trisodium phosphate has given good results, except where zinc bronzes were used in construction. Forced circulation seems to produce a scrubbing effect, regardless of boiler load, which delays scale formation.

In process plants, where steam is used for direct boiling or other purposes involving loss or contamination of feedwater, steam transformers (evaporators) separate the boiler and process-steam circuits, insuring safe operation and protecting prime movers against scale. The idea of separate steam and water circuits appears in somewhat different form in two modern boilers that have met with some success—the Schmidt-Hartmann and the Loeffler. In both cases, good operation in spite of poor water was the goal. Now that successful water treatment is more general, other features of their designs recommend them.

The often limited water volume of modern boilers requires close coordination of steam output, feedwater input and fuel input. This means reliable and quickly responsive control systems. Furthermore, the development of drumless or "once-through" boilers entirely upsets the old scheme of control. Steam pressure was used for the control point with fuel and air flow tied to its variations, and with feedwater supply regulated by drum level and steam flow. Without a drum, and with no water level, the picture becomes different. A common plan involves controlling feedwater by a temperature impulse, to maintain constant superheat.

Entirely aside from special designs, boiler improvements have resulted from a standardization program, although it has been more extensively applied to the generator and turbine end, and to piping. However, boiler parts have been standardized in Central Europe, including tubes, manholes, headers, ash and slag doors. Further, a standard series of pressures and temperatures has been established. The Public Utilities Association of Germany proposes standard pressures of 32, 40, 64, 80, and 125 atmospheres, and temperatures of 425, 450, and 500 C (corresponding to 470, 588, 940, 1176, and 1840 lb; 797, 842, and 932 F).

Boiler Standardization

Regarding the standardization of entire boiler units, W Seeberger, prominent Berlin steam engineer, points out that "successful standardization can only begin after the scientific and technological developments have reached a decisive stage, while today the very diversity of types shows that we are still a long way from the standard boiler."

Thus far we have talked of general trends and the reasons behind them. The following pages present, in more detail, some boiler designs exemplifying these trends. These units have all achieved a definite measure of commercial success in Europe. They thus contain features of engineering worth, even though of questionable economic value for American conditions.

New Method of Rating Boilers

The old standbys "boiler horsepower" or "square feet of heating surface" don't make much sense when you try to use them on modern boilers. Even the more sensible "pounds of steam per hour" rating is not entirely satisfactory. In Europe, a new method of rating, based on "S" values, is coming into wide use. S represents output of a boiler, in terms of kilowatts, compared to its size:

$$S = \frac{H \times E \times R}{860\,V}$$

Where S = Kw generated per cubic metre of boiler

H = Heat (in kilogram-calories per hr) in fuel burned, with boiler operating at manufacturer's rating

E = Over-all efficiency of boiler, %, including superheater, economizer, etc, at manufacturer's rating

R = Ratio $(h_1 - h_2) \div (h_1 - t)$ where h_1 = total heat of steam generated, h_2 = total heat of steam after expansion in a perfect prime mover, and t = feedwater temperature, C

V = Total volume of boiler unit up to damper, including brickwork, gas duct, foundations, firing equipment, and accessories, in cubic metres

860 = Mechanical equivalent of heat, kilogram-calories per kwhr

AVERAGE S VALUES

Standard natural-circulation, drum-type, water-tube boilers	10-15
Forced-circulation boilers	15-20
Once-through boilers	20-25
Modern automobile steam boilers (for comparison)	300

Schmidt-Hartmann

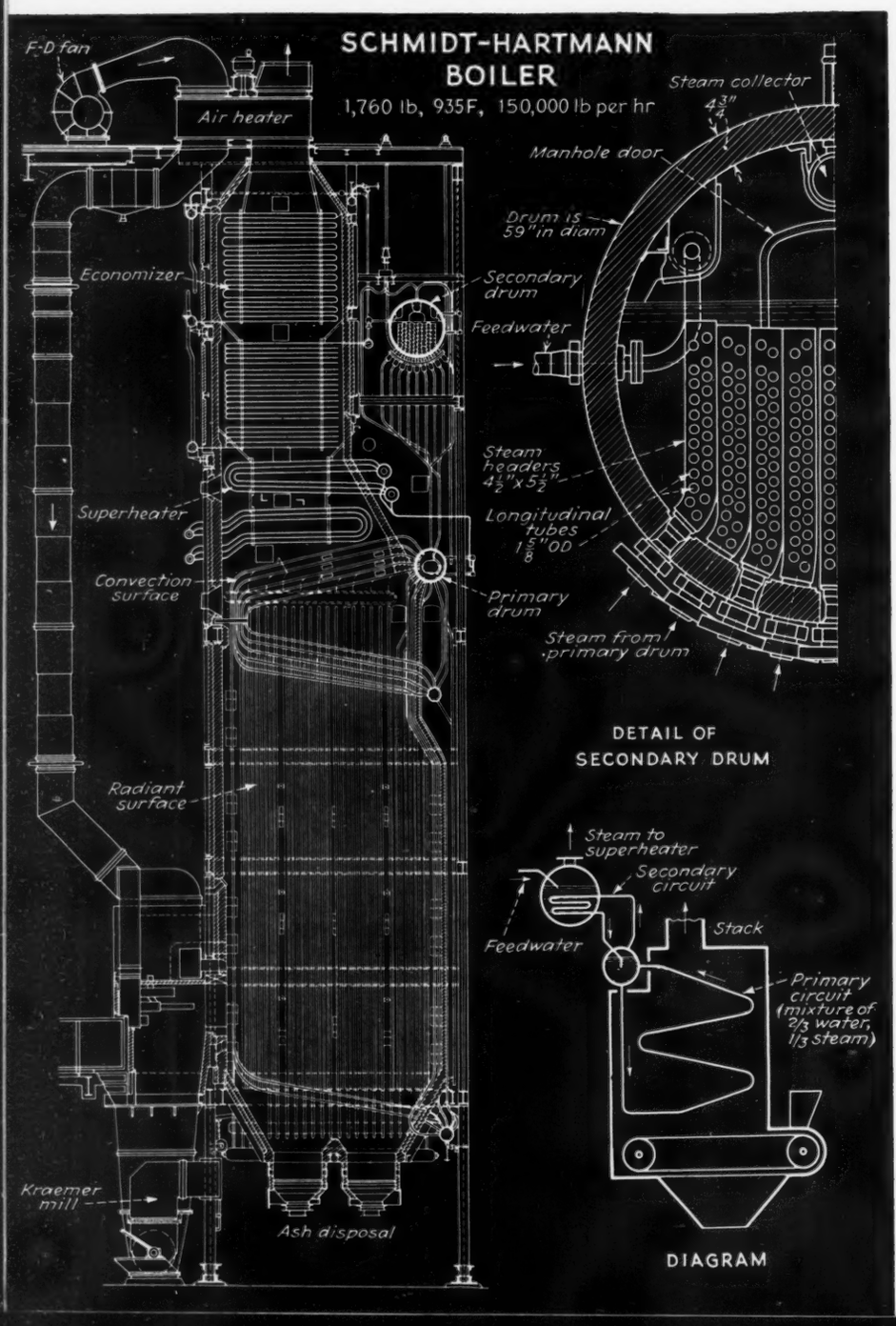
THIS IS A NATURAL-CIRCULATION double-circuit boiler in which steam made from distilled water in a primary circuit exposed to furnace heat vaporizes feedwater in a secondary drum. This design avoids scale formation in steam-generating tubes and produces steam of exceptional purity.

Construction

The primary circuit is closed and only small leakage losses must be made up. Schmidt-Hartmann boilers are built for natural circulation, but there is no inherent reason why forced circulation couldn't be applied to the primary circuit, if desirable.

Feedwater enters the secondary drum in the usual fashion, and water temperature may be raised by an economizer if desired. Steam from the primary drum passes up into the secondary drum, entering headers and tube bundles resembling somewhat the headers and tubes of a sectional-header boiler. Primary steam circulating in these tubes vaporizes the feedwater and the steam thus formed passes to a direct-fired superheater.

Since there must be some final temperature difference between the primary steam and the steam formed in the secondary drum, pressure in the primary circuit must be higher than in the secondary. Other factors remaining constant, the pressure differential depends on the steam output of the secondary circuit. In actual operation, fouling of the secondary-drum tubes introduces an additional factor. For this reason, a margin of safety is provided in setting the maximum pressure of the primary circuit. It has been shown that plants with good water treatment can run these boilers without cleaning for more than 20,000 hours, with safety.



Control

Controls for Schmidt-Hartmann boilers closely resemble those for conventional natural-circulation boilers. Feedwater regulators work from the level in the secondary drum.

Characteristics

The Schmidt-Hartmann boiler aimed at overcoming troubles with poor water for high-pressure operation. Improvements in water-treatment methods relegated this feature to a secondary role: today, most stress is laid on their ability to produce high-purity steam. This latter characteristic seems to result from the even distribution of evaporating elements in the water mass of the secondary drum, from the stability of the water level in the secondary drum, and finally, from a marked cleansing action produced by the definite head of water above the evaporating elements in the secondary drum, acting on comparatively small steam bubbles. The latter action can be demonstrated by letting the water level in the secondary drum fall below the top evaporating tubes; steam purity immediately suffers.

Space and material requirements of Schmidt-Hartmann boilers are approximately the same as those of conventional natural-circulation types. In a boiler having 32,300 sq ft in evaporator, superheater and economizer surface, and 21,500 sq ft in air-heater surface, the secondary heating elements only add 1930 sq ft. Inherently high heat-transfer rates from condensing vapor to evaporating liquid account for the relatively small surface required.

How and Where Used

A large number of boilers of this type are in service in Europe, particularly in industrial plants where steam purity is essential to the process. Schmidt-Hartmann boilers are made for a wide pressure range (500-1800 lb) and in sizes ranging from 15,000 lb per hr to over 200,000 lb per hr. It is interesting to note that one large German boilermaking firm, licensed to make nearly all types, built for pressures above 500 lb more Schmidt-Hartmann boilers than any other type. These figures are for production to January, 1939.

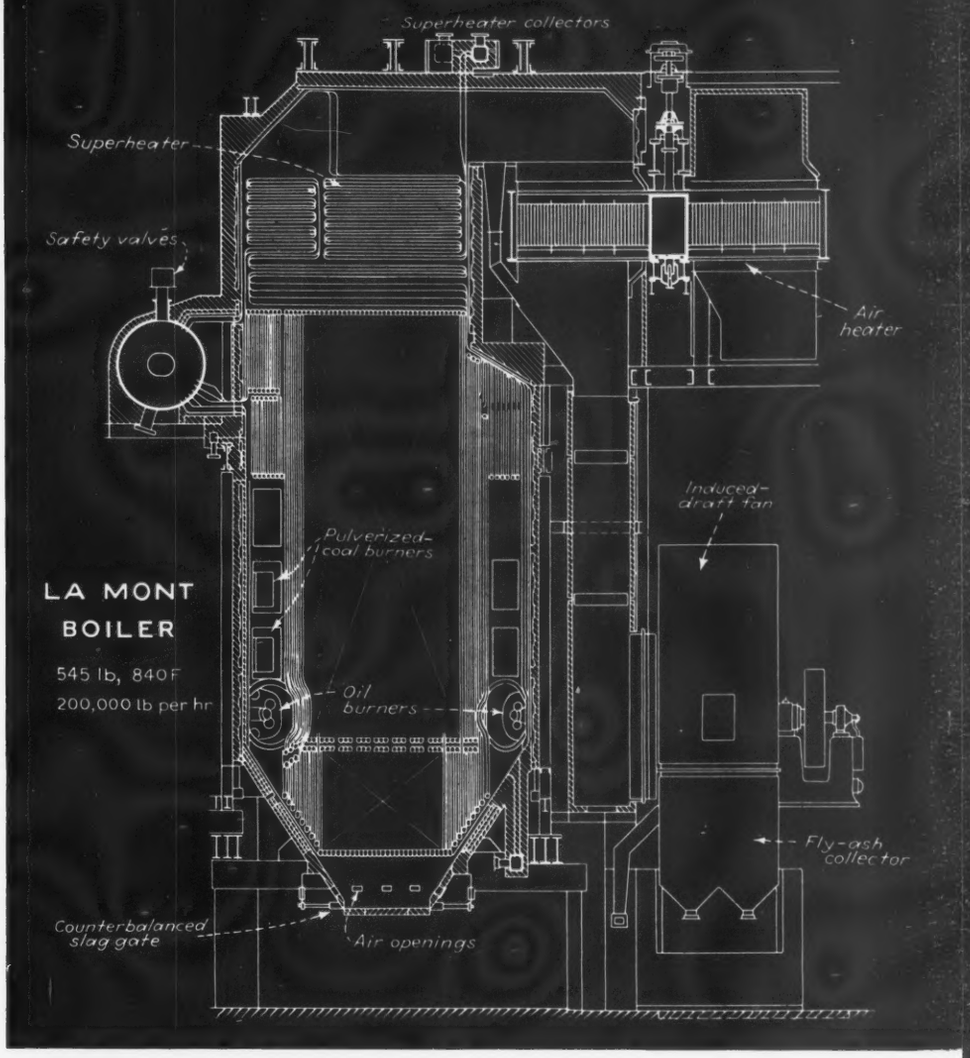
La Mont

THIS IS A FORCED-CIRCULATION "spill-over" boiler with orifices in individual tubes to control distribution of water in the numerous parallel circuits. The orifice principle permits arranging boiler surface in any desired shape, since tubes of different lengths and different degrees of exposure to furnace heat receive water in amounts adequate to prevent overheating.

Construction

The arrangement of the small-bore (1.5-in.) evaporating tubes depends only on space available, except, of course, that unnecessary bends are avoided to keep pumping head to a minimum. The drum, which separates the water circulation from the superheating system, can be located at any convenient place outside the furnace. The feed pump handles water through the economizer to the drum, in the usual fashion; the circulating pump takes its suction from the drum and discharges into the various distribution headers for the parallel tube banks. The sharp-edged throttling orifices, at the tube entrances, control distribution and permit circulating less water without danger of overheating tubes. Steam from the drum passes to a superheater; final temperature is usually regulated by a gas bypass.

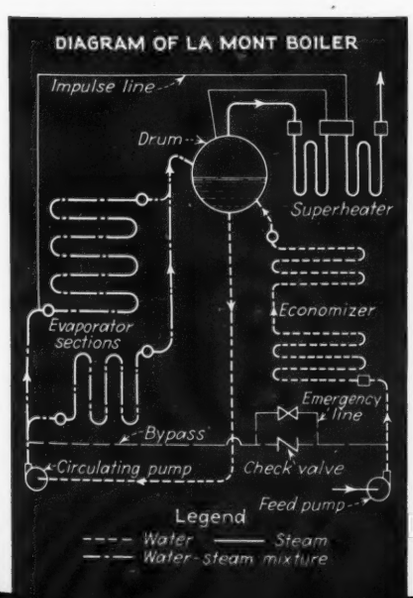
Interconnecting the discharge lines of the feed and circulating pumps protects both economizer and evaporating section. At low steaming rates, the amount of water circulated by the pump becomes greater, since less steam is being withdrawn. On the other hand, feed-pump output decreases and feed-line pressure drops. Excess pressure in the circulating line opens the check valve and the circulating pump supplies the economizer. This assures a constant supply of feedwater to the economizer, eliminating danger of over-heating. By bringing the emergency valve into use, the feed pump can supply the evaporating section if the circulating pump should fail.



With the La Mont design, it is extremely important that orifices be of the right size and that tube length be inversely proportional to the heat transmission in the zone where the tube is.

To some extent, pressure influences the feedwater purity required. However, the La Mont boiler introduces no new problems in this direction, since treatment and blowdown operations can be carried out exactly as in conventional boilers. Internal mechanical cleaning won't work with the smaller tubes and bending radii used in this and other forced-circulation designs. Acid solutions, with metal-attack inhibitors, do the cleaning job.

Power consumption of the circulating pump depends on how much throttling there is at the orifices, on the water volume circulated, and to some extent on the length and shape of the tubes. Usual circulation rates range from 5 to 8, and the average pressure differential is 30-40 lb. Tests on five different La Mont boilers, with outputs of 30,000 to 50,000 lb per hr and total auxiliary power loads running about 2.8 to 3.9 kw per 1000-lb capacity, show power requirements of the pump to lie between 0.45 and 0.65 kw per 1000 lb. This amounts to about 13-17% of the total auxiliary power, or about 0.5-0.7% of boiler output.



Control

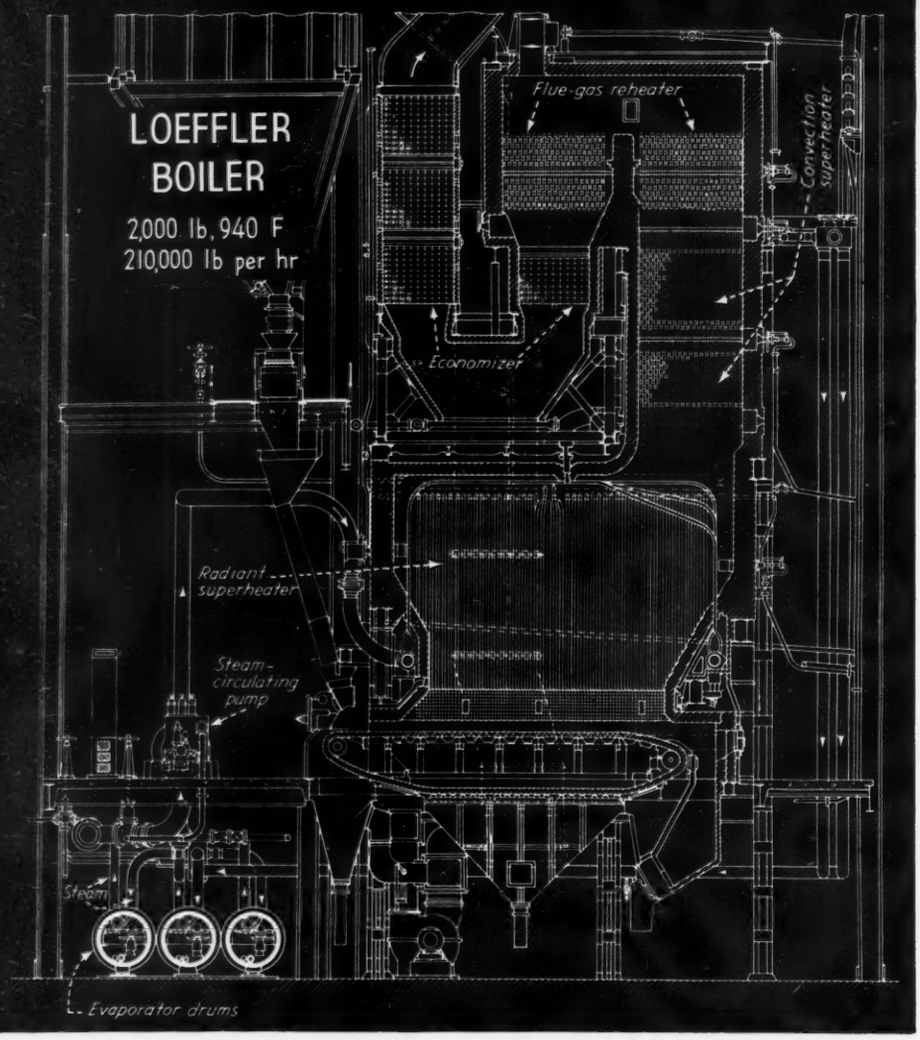
While automatic control is entirely practical and has been provided in a number of installations, the majority of European La Mont plants have manual control. The comparatively large water reserve means that control need not be critically sensitive.

Characteristics

Extreme flexibility in design results from controlled distribution and forced circulation. Small-bore tubes can be used, giving a unit with high specific output. Retention of drum simplifies treatment, blowdown, and control.

How and Where Used

There are more La Mont units in service than any other special boiler; the total number is probably several hundred. The design is suitable for either low or high pressure and for either large or small outputs.



Loeffler

DESIGNED TO OVERCOME FEEDWATER difficulties of high-pressure-boiler operation, this forced-steam-circulation boiler has only superheater and economizer sections in the furnace and gas passages. Evaporation takes place in drums outside the furnace. About ⅔ of the superheated steam generated goes back to the evaporator drums to convert feedwater into saturated steam, which is pumped through the superheater sections.

Construction

Heating surface in the furnace and gas passes consists of a radiant and a convection superheater, and an economizer. In the boiler illustrated, parallel tube circuits (1⅛ in. OD), running from a header at the front, form front wall, roof, and rear wall; steam passes from the rear header to sidewall headers and upward through additional radiant surface on the sidewalls. Upper sidewall headers discharge into a convection superheater with 2⅛-in. OD tubes. The boiler is equipped with a flue-gas reheater, but this is, of course, not an essential feature of Loeffler design.

Superheated-steam flow from the convection superheater divides, about ⅓ going to the prime movers, and the remainder going to the evaporator drums. In these cylindrical forgings, the superheated steam bubbles through the feedwater to make saturated steam at high pressure. Feedwater enters the drums via an economizer, in the usual way. Sludge accumulates in a small drum below the evaporator drums and is blown down at intervals.

A variable-speed pump circulates the saturated steam from the drums through the superheater sections. The pump has a stainless-steel impeller and the shaft is fitted with a labyrinth gland supplied with superheated steam to balance pressure of saturated steam in the pump. The pump is driven by a steam turbine.

In the 2000-lb boiler illustrated, the pressure drop through the superheater circuits, which the pump must overcome, is 70 lb. It can be seen that at lower pressures, steam volume would be greater and pump work would be markedly increased. No particular technical difficulties seem to have been experienced with the pumps. Steam leaving the pump is slightly superheated due to pump work.

Control

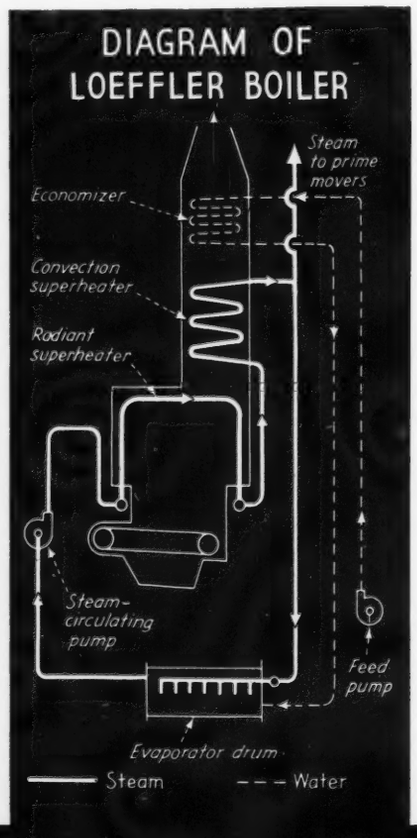
Increasing or decreasing pump speed, thus raising or lowering the transfer rate in the convection section, controls superheat. Heat storage of drums makes it unnecessary to employ controls of high sensitivity.

Characteristics

Satisfactory performance in spite of poor feedwater and effective superheat control are the chief operating features of these boilers. It is reported that drum concentrations as high as 8000 ppm failed to produce appreciable superheater deposits in Loeffler boilers. No particular control problems are involved. Small-bore tubes and high transfer rates in the radiant superheater contribute to lightness and low cost, but drums and high-pressure steam piping add complication, weight, and expense. This design cannot be economically justified except for high pressures where circulating-pump power can be kept within reasonable limits.

How and Where Used

More than a score of Loeffler boilers are in service. Outstanding installations include Brimsdown Station, England (two 2000-lb, 940-F, 210,000-lb-per-hr units), Vitkovice Steel Works, Czecho-Slovakia (original plant), and the SS Conte-Rosso. All of these installations are high-pressure, high-temperature units.



Benson

THIS IS A DRUMLESS, "once-through" boiler. Feedwater is pumped into one end of the boiler circuit and makes a continuous passage to the superheater outlet where an equal quantity of steam is discharged. Impurities deposit in a "transition zone" out of furnace heat; they are removed by flushing.

Construction

The small-bore furnace tubes are usually arranged in vertical bundles, with upward flow in all tubes. Cold downtakes connect the top header of one bundle to the bottom header of the next. Other sections consist mainly of horizontal tubes. There is no brickwork in the combustion chamber.

No sharply defined limits separate the different evaporation stages. Roughly speaking, however, there is an economizer section, a radiant-heating section, where most of the heat is transmitted, a transition section where evaporation is completed and superheating begins, and a superheater section to obtain final temperature. The diagram shows the relative positions.

In early designs, dissolved solids deposited at the point where the steam-water mixture turned into dry steam, which was close to the point of highest heat absorption. This meant scale, localized overheating, and tube failures.

Heating surface is now arranged so that the mixture leaving the radiant section runs about 70% steam, 30% water. This insures holding dissolved solids in solution until the transition section is reached. By putting the transition section out of the radiant furnace heat, in a lower temperature zone, deposits of solids do not endanger the tube walls. The flushing action in starting up the boiler and in shutting down, will wash out the loose scale formed. Where boilers must be run for long intervals they are equipped with piping and valves to flush out the boiler at regular intervals. This is done by pumping water through the unit at about ⅓ the evaporation rate, for about one hour.

Control

The Benson boiler can be controlled by hand but it is normally provided with automatic controls. Use of superheat temperature to indicate response to load changes has been abandoned, as the time lag was too great. To attain maximum sensitivity in the indication of changes in equilibrium between steam production, firing rate, and feedwater supply, control is now effected through variations in the temperature differential in a convection-heated boiler tube of small diameter. This tube bypasses a throttling orifice in the feed line and carries about 1/1000 part of the total feed. It is thus extremely sensitive to changes in feedwater flow and firing rate.

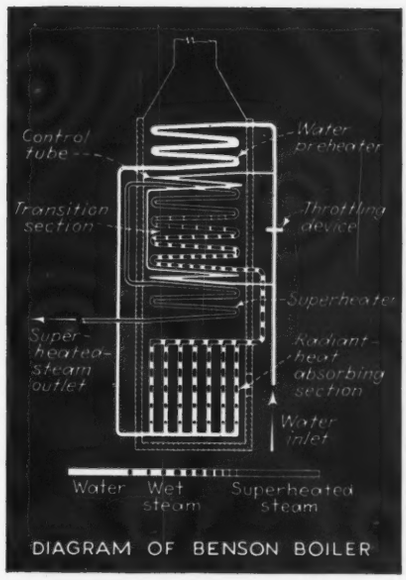


DIAGRAM OF BENSON BOILER

In automatic-control installations, this device acts as an accelerator or corrective control, readjusting the action of the main load-responsive regulators for fuel, air, and water. If, for instance, feedwater flow increases while firing rate stays constant, the temperature differential will drop, furnishing an impulse to correct the fuel and air feed settings.

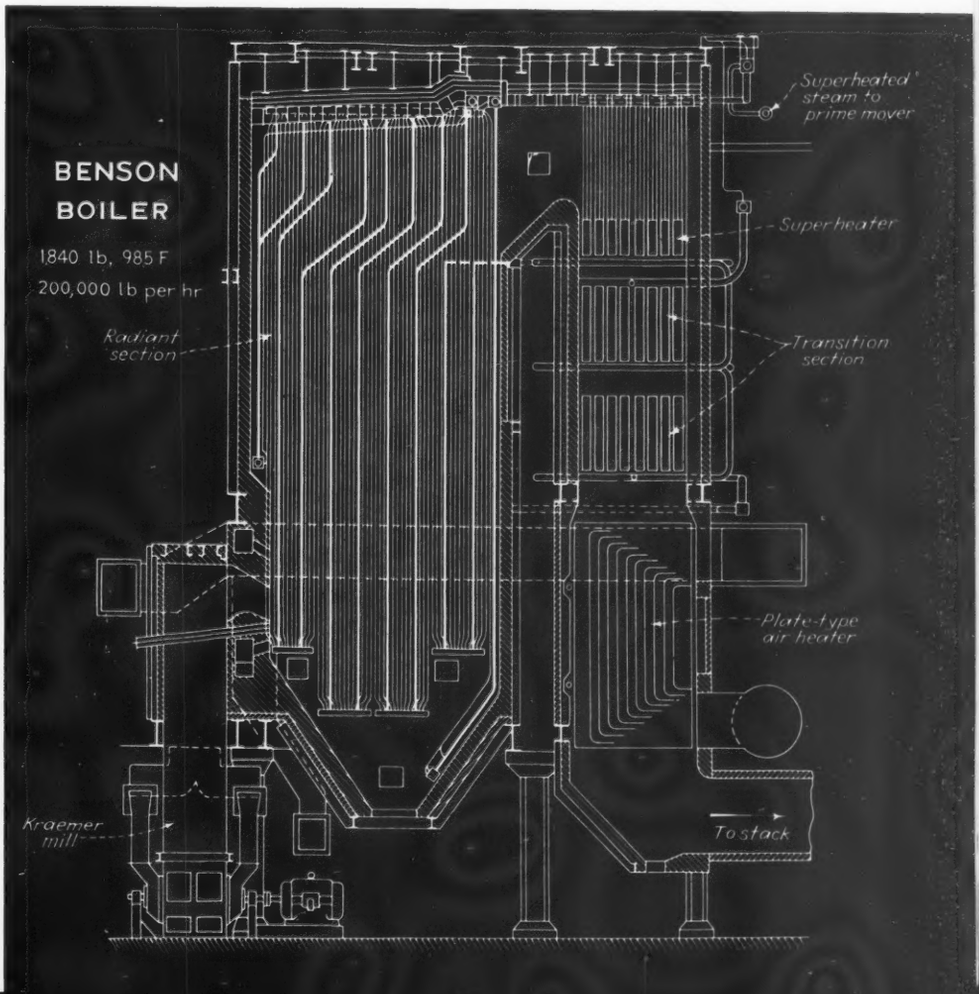
Characteristics

Benson boilers are lightweight, compact units of high specific output. The "once-through" design gives a good factor of safety at high pressures. Flexibility of design permits low headroom installations. Starting time amounts to 10-15 minutes, depending on size of boiler and pressure.

The normal Benson unit has only negligible water reserve, but small drums, outside the casing, are sometimes used to store water (particularly in marine plants). Fairly good water quality is necessary and sensitive controls are important. Nearly any fuel may be burned in a Benson furnace.

How and Where Used

Originally designed for critical-pressure operation, success at lower pressures has widened its field of application. Benson boilers have been built for pressures ranging from 400 to 3300 lb and from 640 to 990 F. They can be built in any size from about 10,000 lb per hr up; the lowest continuous output can be assumed as 10–20% of the rated steaming capacity. As of July of this year, there were 168 Benson units in operation, with an aggregate capacity of over 20,000,000 lb per hr. Probably more than half are in marine service.



Sulzer

THE "MONOTUBE" BOILER is a drumless, "once-through" unit consisting of one or more long tubes. More feedwater enters the tubes than is withdrawn as superheated steam; the difference is blown down by means of a "salt interceptor".

Construction

The main construction elements are tubes of commercial size and quality, the usual size being 1.5 to 2.5 in. These are assembled by oxy-acetylene welding, the complete length forming the economizer, evaporator, and superheater sections. Since there are economic limits on the length of a single tube, several such tubes may be arranged to form parallel circuits for larger boilers. Each tube, however, remains separate from economizer inlet to superheater outlet, and thus forms a complete evaporating unit in itself.

Tubes are exposed to both radiant and convection heat. As circulation is controlled, any desired arrangement of elements is feasible. The total flow section is sized to give a velocity that will insure satisfactory steaming rates without overload on the heating surfaces.

In this design, removal of dissolved solids is effected by means of a "salt interceptor." This interceptor, or separator, lies between the main evaporating section and a secondary evaporator. It separates water from the steam; the water content of the mixture going from the separator to the secondary evaporator is controlled by thermostat *A*. A blowdown valve handles discharge of water and dissolved solids from the separator. Usually about 1-2% of the water in the system is blown down continuously. Since the evaporation zone is never displaced, the exact location for the interceptor can be determined beforehand.

Control

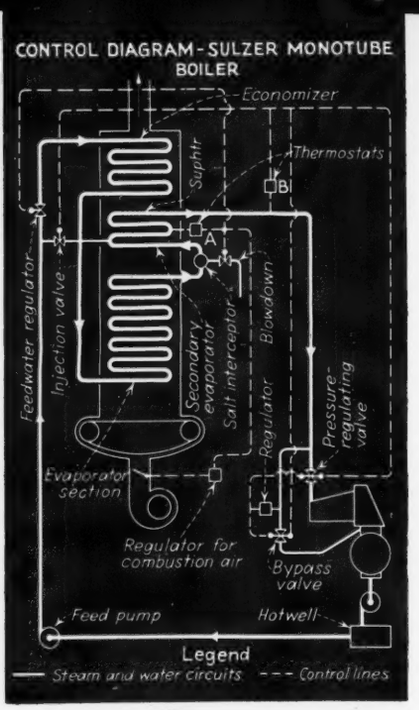
The diagram shows the control hookup for a Monotube boiler. Feedwater enters the economizer through a regulator and then flows into the main evaporator section. The steam-water mixture goes through the "salt interceptor" for blowdown, and then into the secondary evaporating surface. The superheater discharges to the turbine through a pressure-regulating valve, and a bypass is provided around the turbine.

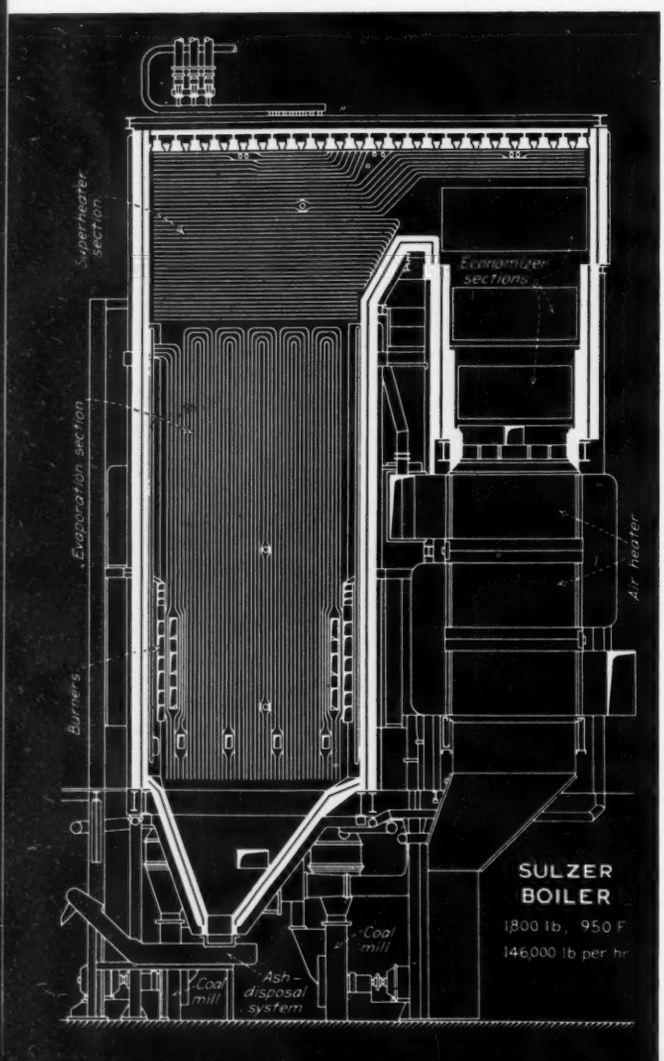
Thermostat *A* serves as the basic control, and the relatively small amount of surface between the interceptor and the control point gives the sensitivity to furnace changes necessary for close regulation. This thermostat influences regulators for air supply and for feedwater flow, and controls the amount of blowdown, thus affecting the water level in the interceptor and the amount of water in the steam-water mixture going from the interceptor to the secondary evaporator section.

Thermostat *B* provides secondary regulation and protects the prime mover against excessively high or low temperatures. Its basic job is to control final superheat temperature by means of an injection valve regulating flow of desuperheating water into the circuit ahead of the superheater.

The regulating valve ahead of the turbine and the bypass valve are tied to a pressure controller and to thermostat *B*. If the pressure falls, the controller closes the steam inlet valve to the turbine. Conversely, if the pressure increases, as in the case of a turbine shutdown, the steam goes through the bypass before the boiler safety valves take effect. This pressure control compensates for irregular circulation and protects the turbine from surges. If temperature exceeds set limits, thermostat *A* closes the regulating valve ahead of the turbine and opens the bypass.

In starting the unit, feedwater circulates through the entire system and goes through the bypass until proper pressure and temperature are reached. As soon as saturated steam is available, the pressure controller and the valves adapt themselves to normal operation and when the required pressure has been reached, the regulating valve opens and admits steam to the turbine. Oil-fired Sulzer boilers can be started from cold in about 5 minutes.





Characteristics

Boilers of this type offer low first cost, compactness and light weight. They are flexible in operation and start quickly. Reliable and quickly responsive controls are necessary; water reserve is negligible; good water quality should be maintained. There is little or no restriction on the type of fuel.

How and Where Used

There are more than 30 Sulzer Monotube boilers in commercial service, with an aggregate capacity of slightly more than 2,500,000 lb per hr. Most are installed in industrial power plants, but some are in central stations and one in marine service (S S Kertosono). Individual units range in capacity from 14,000 to 250,000 lb per hr, and generate at pressures from 450 to 2250 lb and at temperatures from 500 F to 1000 F.

Velox

EMPLOYING AN EXHAUST-GAS-TURBINE-DRIVEN COMPRESSOR to maintain a pressure of 35 lb in the furnace of this forced-circulation boiler results in extremely high heat release, efficiency and heat-transfer rates. All auxiliaries are automatically controlled.

Construction

As shown in the diagram (for a gas-fired unit), turbo-compressors supply fuel gas and combustion air to the boiler furnace under pressure. The boiler includes a superheater, a separator, and a circulating pump. Flue gas passes from the superheater to the gas turbine (see POWER, June, 1939) and then to the economizer (not shown). The gas turbine, and an auxiliary steam turbine for starting, drive the shaft mounting the air and fuel-gas compressors. In most stationary plants, a motor serves to start the unit.

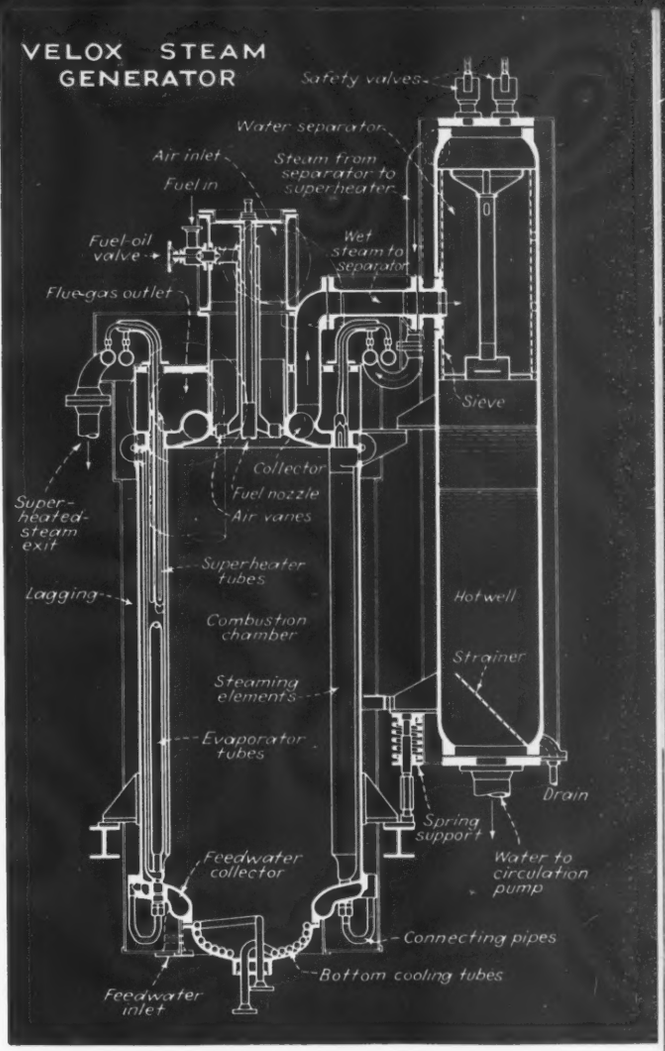
The boiler proper consists of a combustion chamber of small dimensions surrounded by heat-absorbing elements. The fact that wall temperatures do not exceed 900 F (because of rapid heat transfer) means that no refractory is required. The top-mounted burner consists of a single nozzle surrounded by deflectors to produce intense turbulence. Air enters at about 30-40 lb; this pressure varies with load. By creating nearly ideal conditions for combustion, excess air can be cut down to about 10% at full load.

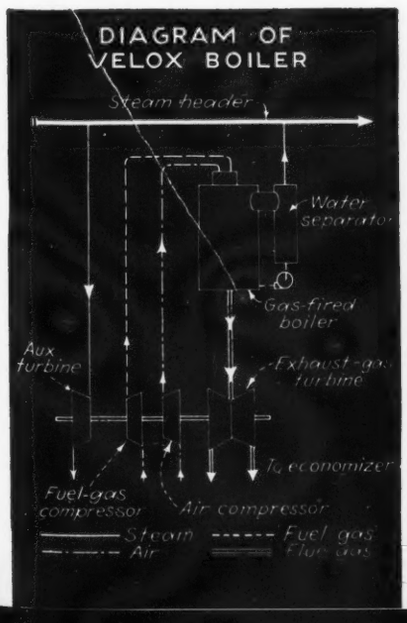
Combustion gas travels down the interior of the boiler and enters into the steaming elements near the bottom. In its upward passage, it flows past evaporator and superheater tubes at velocities of 700-1200 fps, producing evaporation rates of more than 100 lb of steam per hr per sq ft.

The circulation pump maintains a circulation ratio of about 10. Water flows upward through evaporator elements into an upper collector discharging into the separator. The tangential entrance produces a centrifugal action causing separation. The water falls through the sieve into the hotwell; dry saturated steam leaves at the top for the superheater.

Cooling coils line the furnace bottom. Glass wool or equivalent material fills the lagging spaces and a sheet-metal cover adds to the appearance of the unit. To prevent expansion strains on individual parts, spring supports are provided.

In ordinary designs, with fan power supplied from an external source, gas velocities exceeding 75-100 fps, with resulting prohibitive pressure drops, would mean uneconomically high power consumption. The exhaust-gas turbine overcomes this difficulty; about ¾ of the useful compression work is recovered in the turbine, while the rest overcomes duct friction.





Heating surfaces precede and follow the gas turbine. The range of temperatures in the turbine is such that operating troubles are minimized and yet sufficient efficiency is retained.

Control

An oil-hydraulic system regulates fuel, air, and feedwater supply. Level in the separator is kept virtually constant and special safety devices protect against water shortage, faulty circulation, or excessive compressor speed.

Characteristics

Pressure combustion cuts air requirements down close to theoretical, and allows heat liberation rates of 800,000 to 1,000,000 Btu per cu ft per hr. Reduced gas volume permits low exit temperatures in spite of limited surface, so that efficiencies of 90% and more are feasible even at low ratings. High velocities and resulting high transfer rates reduce required heating surface. The result is a boiler of extremely small size.

Oil-fired units at Toulon and Haifa registered over-all efficiencies of 92.5-93%. Blast-furnace-gas-fired boilers at Mondeville Station operate at 86-89% because low heating value and comparatively high temperature and specific volume of blast-furnace gas resulted in high compressor power consumption.

Reduced masses and flexible design permit rapid starting. At Wellington, New Zealand, Velox units went from cold to full load in 3 min. 45 sec.

Narrow gas passages restrict the range of fuels which can be burned successfully to those that are relatively ash free. Although compact and light in weight, the high standard of precision required in manufacture of Velox boilers means increased cost.

How and Where Used

Approximately 75 Velox boilers are in use or on order as of Nov 1, 1939; the aggregate capacity of these units is over 3,000,000 lb per hr. Most are for industrial power plants, some have been installed in central stations and institutions. The number includes 10 for marine and naval service, 1 for locomotive, and 9 for hot-water production. Pressures range from 215 to 1150 lb with most in the 500-lb class; temperatures range from 350 F to 940 F. Capacities of individual units range from 8800 lb per hr to 176,000. Many Velox boilers are used as standby or emergency sets.

Modern European Boilers Compared

Type	Examples	Steam Generated Mostly By:	Usual Pressure Range	Advantages	Disadvantages	Remarks
Conventional Natural Circulation	Typical multi-drum boilers	Convection	Up to 1500 lb	Simple in operation. Ample water reserve	Long starting period. Expensive and bulky at high pressures	Relatively insensitive to poor feedwater
	"Drumless" boilers	Radiation	250-2000 lb	Increased operating safety. Shorter starting time. Less expensive	Lower water reserve. Needs intelligent operation or automatic control	In some, water volume is still appreciable
Reinforced Natural Circulation	"Chimney" boiler	Convection or Radiation	Up to 1800 lb	Permits using small tubes with natural circulation	Excessive headroom. Careful lagging needed	Still experimental
Indirect-Natural Circulation	Schmidt-Hartmann boiler	Primary cycle: Radiation Secondary: Conduction, Convection	Primary cycle: 1400-2600 lb Secondary: 500-1800 lb.	Exceptionally pure steam. Easily controlled. Can handle poor feed	Somewhat heavier and more expensive than standard natural circulation boilers	Important in chemical and processing industries
Centrifugal-Natural Circulation	Vorkauf boiler-turbine	Convection	200-1700 lb	No feed pump necessary. Compact, high efficiency units	Mechanical complication. Careful balancing needed	Still experimental
	Huettner boiler-turbine	Convection	200-750 lb			
Forced Circulation — Water	La Mont boiler	Radiation	400-1800 lb	Good tube cooling even at part load. Small tubes, compactly arranged	Power taken by circulating pump. Added complication	Both have drums, simplifying blow-down and control, but increasing cost
Forced Circulation — Steam	Loeffler boiler	Radiation	1400-2100 lb	Effective superheat control. Can operate at high pressure on bad feedwater	Uneconomic for low pressure. Higher pump power than for water circulation	
"Once-through"	Benson, Ramsin boilers	Radiation	400-3000 lb	Simple, compact design. Fits space available. High safety factor. Low first cost	Requires field work in erection. Suphr control occasionally difficult	Marine units sometimes fitted with drum
	Sulzer "Monotube"	Radiation	500-2500 lb		Requires "salt interceptor," intricate control	Most suitable for high pressure
Forced Circulation with pressure combustion	Velox boiler	Convection	200-600 lb	High efficiency. Quick starting. Flexible operation. Extremely compact	Limited to ash-free fuels. High-grade workmanship required means higher cost	Good standby or emergency unit

Bibliography

LISTED BELOW are the principal publications in the field covered by this survey. Because most of the basic work in investigating and developing the "super" boiler has been done on the Continent, the foreign-language publications contain the basic data. In many cases, however, the same data will be found in English papers, so both are listed.

AMERICAN PUBLICATIONS

Benson Boiler Developments, F Hodgkinson— P 12/38—ME 3/39

Is America Ready for Forced Circulation?, A R Smith—C 2/39

The Benson Boiler, F Michel—C 7/36

Forced Circulation, F Muenzinger—C 2/36

Flow Distribution in Forced-Circulation Once-Through Steam Generators, Potter, Solberg, Hawkins—ASME 7/35

Velox Steam Generator, A Meyer—ME 8/35

Benson Boiler and Its Applications, F Hodgkinson—C 3/1935

Special and Superpressure Boilers for Industry—PPE 1/34

Load Regulation by Pressure with Benson Boiler, H G Gleichmann—C 6/34

Some Experiences with the Benson Boiler, H G Gleichmann—C 3/34

Sulzer Single-Tube Steam Generator—PPE 3/34

Review of Recent European Boiler Designs—C 9/33

Benson Land and Marine Boilers, F Ohlmueller—ME 1/33

Characteristics of High-Pressure Series Steam Generators, Potter, Solberg, Hawkins—ASME 11/32

Once-Through Series Boiler for 1500-5000 lb Pressure, H J Kerr—ASME 11/32

Loeffler Superpressure Steam Generator, D Brownlie—C 10/32

New Boiler Spins at Turbine Speed, H Vorkauf—P 11/32

Experience with High-Pressure Boilers in Central Europe, A Weisselberg—P 10/21/30

Recent Developments of Benson Boiler, H G Gleichmann—PPE 6/1/30

Problems Involved in Operation with Superpressure Steam, S Loeffler—ME 6/30

Steam Generation of High Pressure and Temperature, S Loeffler—P 3/19/29, 3/26/29

The Use of High-Pressure Steam in Europe in Economic Power Generation, S Loeffler—ME 4/29

The Schmidt-Hartmann Boiler, O H Hartmann—P 10/29/29

Experiences with the Benson Steam Generator, H G Gleichmann—P 5/31/27

The Benson Superpressure Plant, P W Swain—P 5/22/23

The Benson Superpressure Plant—Its Scientific Basis, P W Swain—P 5/29/23

BRITISH PUBLICATIONS

Thermal Power Plants for Peak Load and Emergency Service, H S Hvistendahl—IEE 39 305-41

Trend of Development of Steam Generation in Russia—SE 1/38, 9/37, 10/37

Experience with Benson Boilers at Scholven (abs), H Lent—SE 4/38

Survey of Forced-Flow Boiler Technique—EBHR 10/38, 11/38, 12/38

La Mont Boiler Installation at Works of G & J Weir—EG 10/7/38

Service Results with High-Pressure Boilers, A L Mellanby—IME 4/38

Novel Steam Generators, D W Rudorff—EBHR 8/37, 9/37, 10/37

Benson Steam Generator—EBHR 4/37

Velox Steam Generator for Merchant and Naval Vessels, A Meyer—SNAME 11/37

Loeffler Boiler Installation—SS Conte Rosso, S McEwen—IME 4/37

La Mont Forced-Circulation Steam Generator—EG 5/2/36

Tests on Velox Steam Generator, A Stodola—SE 12/35

Benson Boilers in Liner Potsdam, B Bleicken—E 11/20/36

Monotube Boiler in SS Kertosono—E 6/5/36

Modern Forms of Water Tube Boilers for Land and Marine Use, F Muenzinger—IMEE 11/20/36

La Mont Steam Generators for Stationary Power Plants, D W Rudorff—EBHR 10/35

Symposium on High-Pressure Boilers—IME 4/35

Loeffler System of Steam Production, S McEwen—IF 12/34

Velox Steam Generator in Service, E S Dean—E 12/34

Velox Steam Generator, M G S Swallow—EG 4/20/34, 5/4/34

Influence of Benson Boiler on Development of Power Stations, F Ohlmueller—E 2/23/34

La Mont Steam Generator, A T Herpen—SE 8/33

Benson Boiler at Langerbrugge—E 4/21/33

Loeffler Boiler in Operation, W Bredtschneider—EBHR 11/32

Sulzer Single-Tube Steam Generator, A Stodola—E 11/7/33, 11/24/33

Developments of Loeffler System of Steam Raising—E 11/15/29

FOREIGN-LANGUAGE PUBLICATIONS

Development of Rotary Boiler-Turbine Units, F Huettner—ZVDI 39 397

The Schmidt-Hartmann Boiler in Operation, W Quack & K Kaissling—ZVDI 39 45

Expenditure in Material vs Operating Power in Boiler Design, K Schroeder—ZVDI 39 666

Recent Boiler Types, F Schulte—AW 38 3

The Borsig Feed Accumulator for Steam Boilers, X Reichardt—RBM 3/38

3½ Years of Benson Boiler Building, F Merx—RBM 1/38

Behavior of La Mont Boilers, W Arend & H Hoecker—W 38 479

Tendencies in Modern Steam Power Plants, H Goerke—ZVDI 38 389

Erecting and Operating Experience at Scholven High-Pressure Plant, H Lent—ZVDI 37 1461

Expenditure of Material in Steam Power Plants, E Schulz—ZVDI 37 1393

1500-lb Steam Power Plant with Monotube Boiler and Valve-Gear Steam Engine, C Veit—ZVDI 37 1461

Experience in Feeding Chemically Treated Water to Superpressure Boilers, Wesley & Geisler—CF 37 197

On Design and Possibilities of Application of High-Pressure Boilers, A J Ter Linden—DI 36 65

Feedwater Treatment Methods for Modern Boiler Types, A Splittgerber—ZVDI 35 339

New Ways to Cheaper Peak Load Energy, F Muenzinger—EZ 34 291

Quick-Starting Steam Power Plant, H Kurth—VDEF 34 19

Loeffler Boiler Tests, E Josse—ZVDI 34 771

Control of High-Pressure Boilers, G Wuensch—W 32 321

The Velox Steam Producer, C Seippel—RTL 28 109

The Era of High-Pressure Steam, S Loeffler—ZVDI 28 1353

ACKNOWLEDGMENTS

The editors of POWER and Mr Wulfinghoff are indebted to the following for information in the form of personal communications: Dr F Muenzinger, Consulting Engr, Berlin; Mr R Boese, Chief Engr, Heat Dept, General Electric Co, Berlin; Mr P Grasme, Chief Boiler Engr, Borsig Co, Berlin; Sulzer Bros, Winterthur, Switzerland; Brown, Boveri & Co., Ltd., Baden, Switzerland.

GUIDE TO SYMBOLS

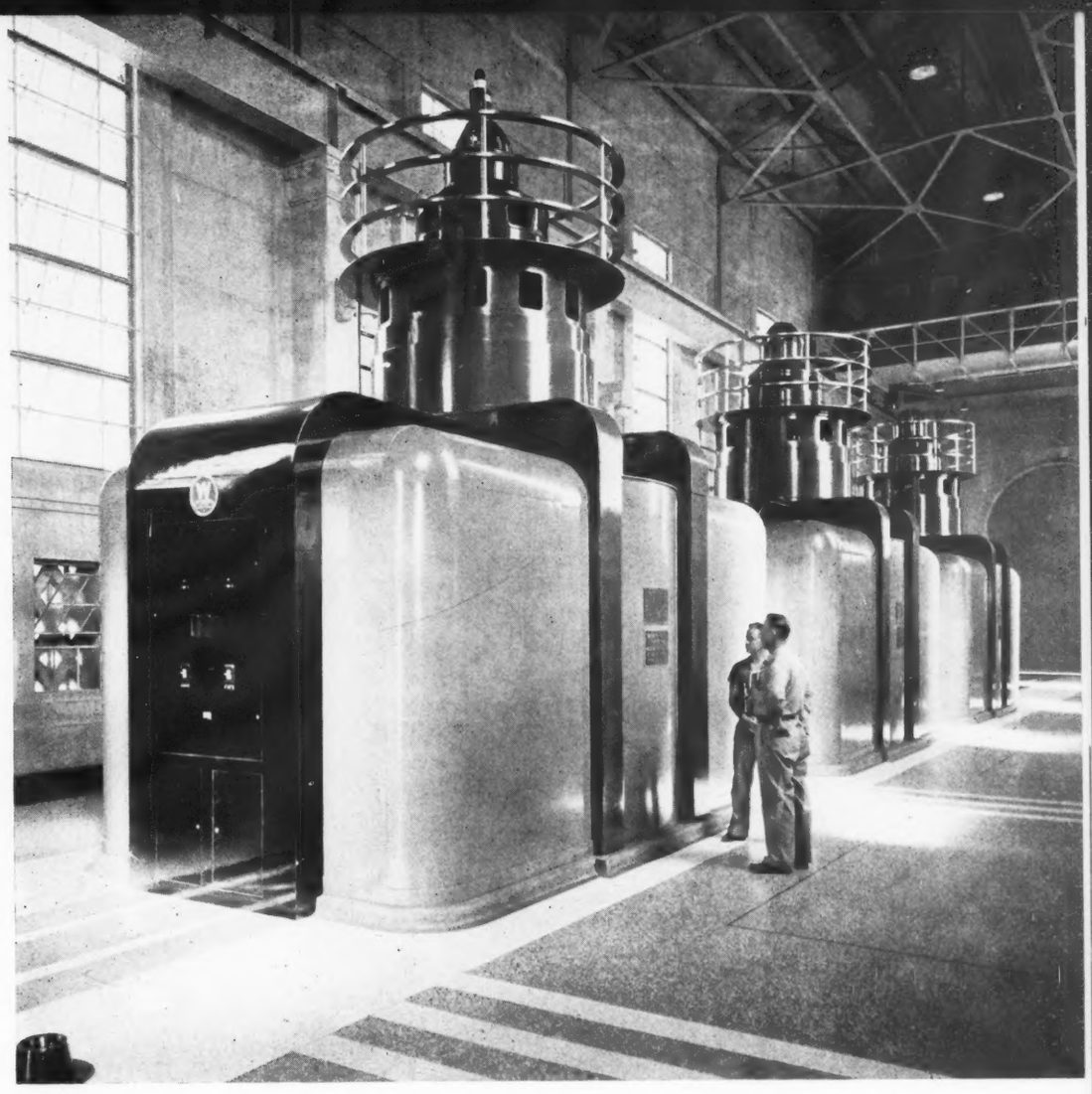
For monthly magazines, the date is given: 3/35. For weekly magazines, 3/10/37. For some foreign-language publications, the year and page are given, thus: 37 465. The following symbols indicate the publications:

AMERICAN: ASME—*Transactions American Society of Mechanical Engineers*; C—*Combustion*; ME—*Mechanical Engineering*; P—*Power*; PPE—*Power Plant Engineering*.

BRITISH: E—*Engineer*; EBHR—*Engineering and Boiler House Review*; EG—*Engineering*; IEE—*Institute of Electrical Engineers*; IF—*Institute of Fuel*; IME—*Institute of Marine Engineers*; IMEE—*Institution of Mechanical Engineers*; SE—*Steam Engineer*; SNAME—*Society of Naval Architects and Marine Engineers*.

FOREIGN LANGUAGE: AW—*Archiv fuer Waermewirtschaft*; CF—*Chemische Fabrik*; DI—*De Ingenieur*; EZ—*Elektrotechnische Zeitschrift*; RBM *Rheinmetall Borsig Mitteilungen*; RTL—*Revue Technique Luxembourgeoise*; VDE—*VDE Fachberichte*; W—*Waerme*; ZVDI—*Zeitschrift Verein Deutsches Ingenieurs*.

Three Westinghouse synchronous motors each deliver 12,500 hp at 450 rpm to vertical pumps with a total capacity of 390,000,000 gpd



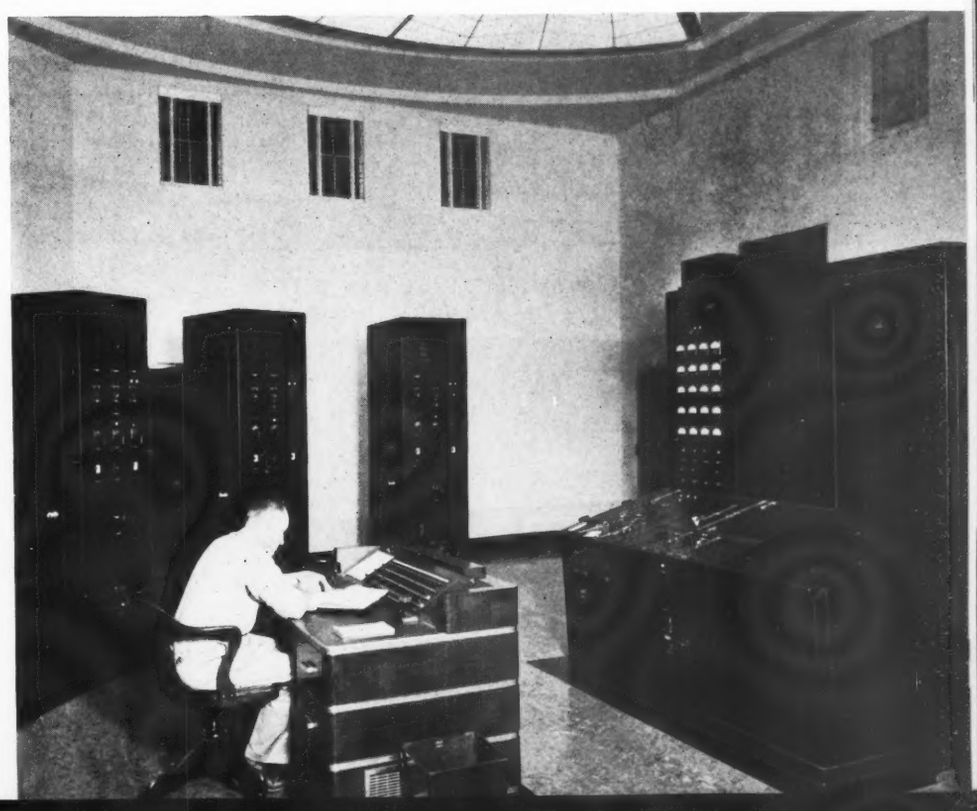
Powerful and Sleek

Motor controls are centered in this neat, smartly finished, air-conditioned room. Three control cabinets are along the wall at left. On the benchboard at right are indicating instruments and automatic-control equipment for the 230-kv oil circuit breakers, disconnecting switches and voltage regulators

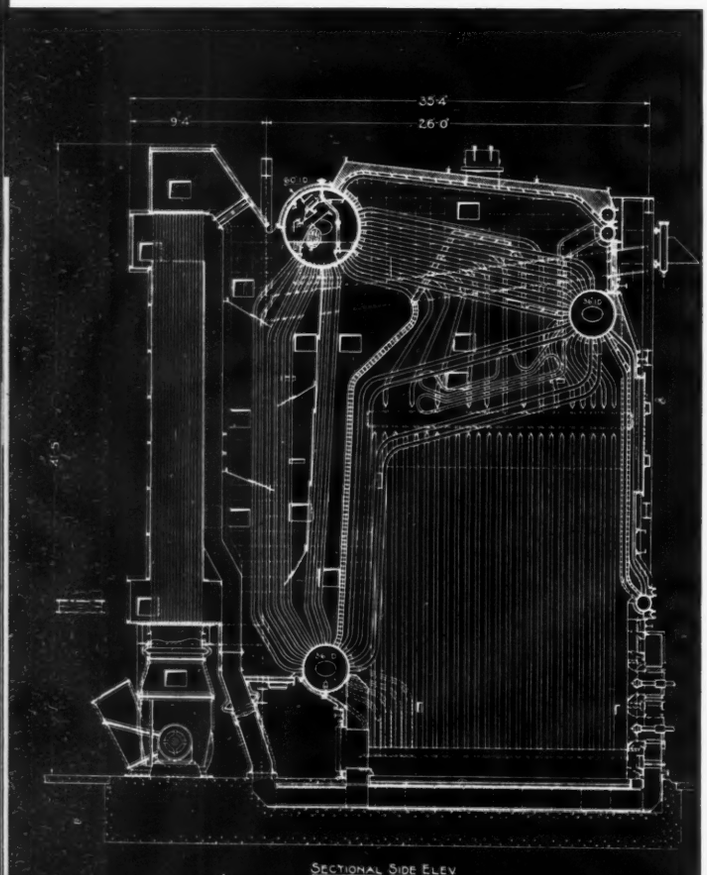
AT THE EAGLE MOUNTAIN Station of the Colorado River Aqueduct, three of the six largest pumping motors in this country will soon go to work lifting water 438 ft on its route from the Colorado River to Los Angeles and neighboring cities. Three identical motors have been installed in the Hayfield Station, where the head is slightly greater—444 ft.

These sleek 12,500-hp giants are started directly across 6900-volt lines, stepped down from the 230,000-volt line from Boulder Dam. The main elements in this great aqueduct project have been nearly completed; delivery of water to coastal cities is expected early in 1940. The project includes a diversion and power dam on the Colorado River 150 miles below Boulder Dam, five pumping stations with a total lift of 1634 ft, and 242 miles of aqueduct, made up principally of 92 miles of tunnels, 55 miles of cut-and-cover conduit, 63 miles of open-lined canals, 29 miles of siphons.

For another photograph of this station, see front cover of this issue.



Riley Boiler Unit doing a sweet job



100,000 lbs./hr. 475 lbs. pressure-560°F Riley Unit
Godchaux Sugars, Inc., Reserve, La.

Carries peak loads of over 125,000 lbs. per hour though maximum guaranteed capacity was 100,000 pounds; average monthly efficiency 85.7% against guaranteed test efficiency of 82%

Plant expansion at the Reserve Refinery of the Godchaux Sugars, Inc., required additional steam generating capacity as well as additional electrical power. After consideration of all factors, it was decided to install a topping boiler and turbine unit. The old units operated at 140 pounds pressure. The best heat balance could be obtained by installing a topping unit to operate at 450 pounds and 560 degrees.

A new 100,000 pound per hour Riley Boiler unit, fired with Dennis gas burners, was selected. This unit has been doing a sweet job for Godchaux since its installation. No difficulties whatsoever were experienced in starting up the unit. It has been in full time operation ever since the installation was completed, except for periodic inspections. The unit has carried peaks of over 125,000 pounds per hour, though maximum guaranteed capacity was 100,000 pounds. Average monthly efficiencies of 85.7% are maintained against a guaranteed efficiency of 82%.

It is because of such plus values, such outstanding performance that Riley has climbed so rapidly to a position of leadership in the boiler industry. It will pay you to investigate some recent Riley installations and see for yourself how well Riley can serve you in meeting your most exacting requirements.

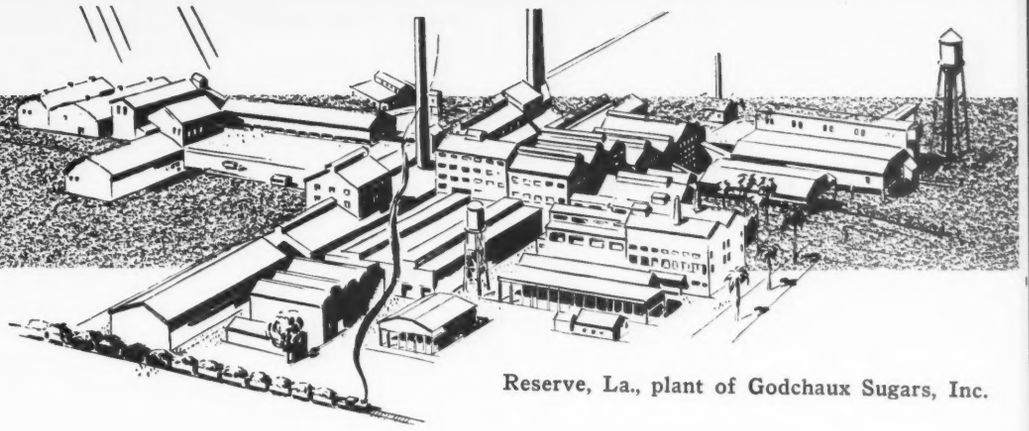
RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Pittsburgh Buffalo Cleveland Detroit Tacoma Baltimore Milwaukee Denver
St. Louis Cincinnati Houston Chicago St. Paul Kansas City Los Angeles Atlanta Memphis New Orleans

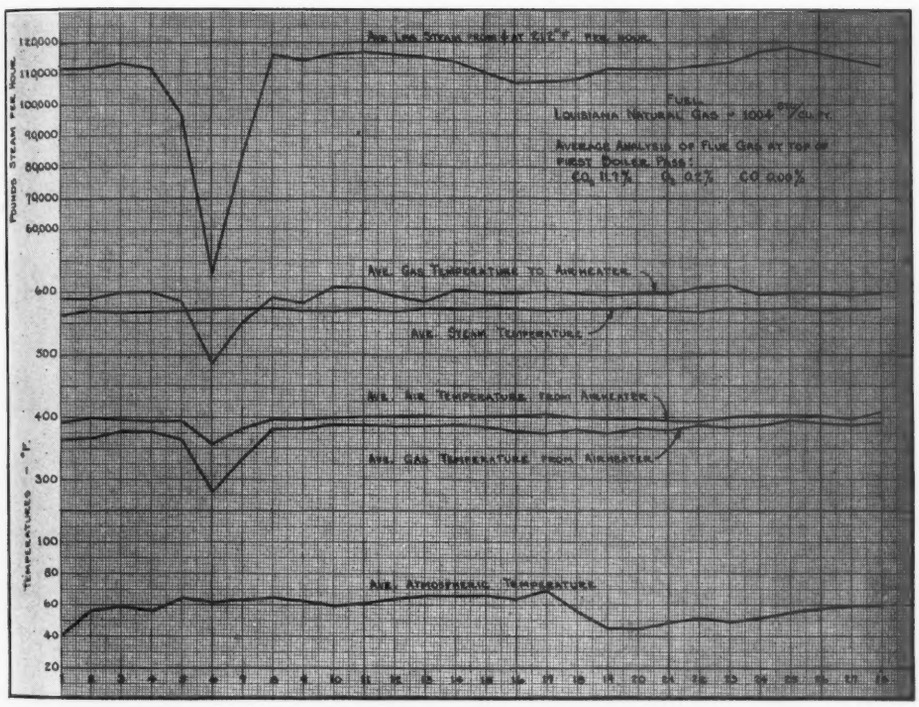
It will pay you to visit modern Riley Installations

The Reserve Refinery is probably the oldest plant in the country that has functioned entirely as a sugar factory throughout its history. It is the only standard refinery in the United States that, in addition to its refining activities, grinds cane during the Louisiana grinding season. 3000 tons of cane per day are ground. Up to 2,200,000 pounds of sugar are refined per day.



Reserve, La., plant of Godchaux Sugars, Inc.

for Godchaux Sugars, Inc.


Pounds Steam per Hour
Temperatures — °F.
Ave. Lbs. Steam from & at 212° F. per hour.
Fuel—Louisiana Natural Gas = 1004 B.T.U. per Cu. Ft.
Average Analysis of Flue Gas at top of First Boiler Pass:
CO2 11.1% O2 02% CO 000%
Ave. Gas Temperature to Airheater
Ave. Steam Temperature
Ave. Air Temperature from Airheater
Ave. Gas Temperature from Airheater
Ave. Atmospheric Temperature

Performance Data Curves

Godchaux Sugars, Inc., Reserve, La.
100,000 lbs. per hour
Riley Boiler Unit

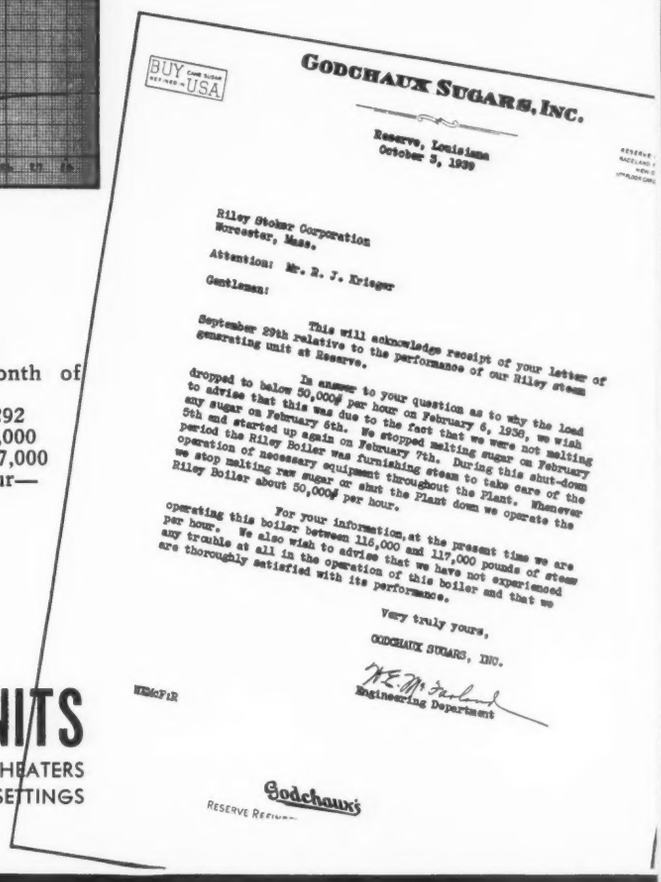
NOTE: That daily average loads of 118,000 lbs. per hour were carried while maximum guaranteed capacity was 100,000 lbs. per hour. Peaks of one hour duration of over 125,000 lbs. per hour were carried. Efficiency of 85.7% obtained against guarantee of 82%. Evidence of plus values obtained with Riley Boiler Units.

ENGINEERING DATA

Maximum Guaranteed Capacity
100,000 lbs. per hour

Note accompanying curve showing daily average production of over 118,000 lbs. per hour. Peak loads of over 125,000 lbs. per hour have been carried.
Drum Pressure—475 lbs.
Steam Temperature—560°F
Furnace Volume—4,200 cu. ft.
Heat Release — 100,000 lbs./hr.-32,300 B.T.U.
Boiler—9200 sq. ft.
Water Walls—1100 sq. ft.
Air Heater—8800 sq. ft.

Guaranteed Efficiency — 82% at 80,000 lbs. per hour
Note actual efficiency below 85.7% at 109,125 lbs. per hour
Actual Performance Data, Month of February
Fuel Consumed, M Cu. ft.—83,292
Pounds of Water Evap.—66,865,000
Equiv. Pounds of Water—73,337,000
Avg. Pounds of Water per hour—109,125
Pressure—453 lbs.
Steam Temperature—569°F
Efficiency—85.7%



BUY CANE SUGAR REFINED IN USA

GODCHAUX SUGARS, INC.

Reserve, Louisiana
October 3, 1939

Riley Stoker Corporation
Worcester, Mass.

Attention: Mr. R. J. Krieger

Gentlemen:

This will acknowledge receipt of your letter of September 29th relative to the performance of our Riley steam generating unit at Reserve.

In answer to your question as to why the load dropped to below 50,000# per hour on February 6, 1936, we wish to advise that this was due to the fact that we were not melting any sugar on February 6th. We stopped melting sugar on February 5th and started up again on February 7th. During this shut-down period the Riley Boiler was furnishing steam to take care of the operation of necessary equipment throughout the Plant. Whenever we stop melting raw sugar or shut the Plant down we operate the Riley Boiler about 50,000# per hour.

For your information, at the present time we are operating this boiler between 116,000 and 117,000 pounds of steam per hour. We also wish to advise that we have not experienced any trouble at all in the operation of this boiler and that we are thoroughly satisfied with its performance.

Very truly yours,

GODCHAUX SUGARS, INC.

WEMcF:R

Engineering Department

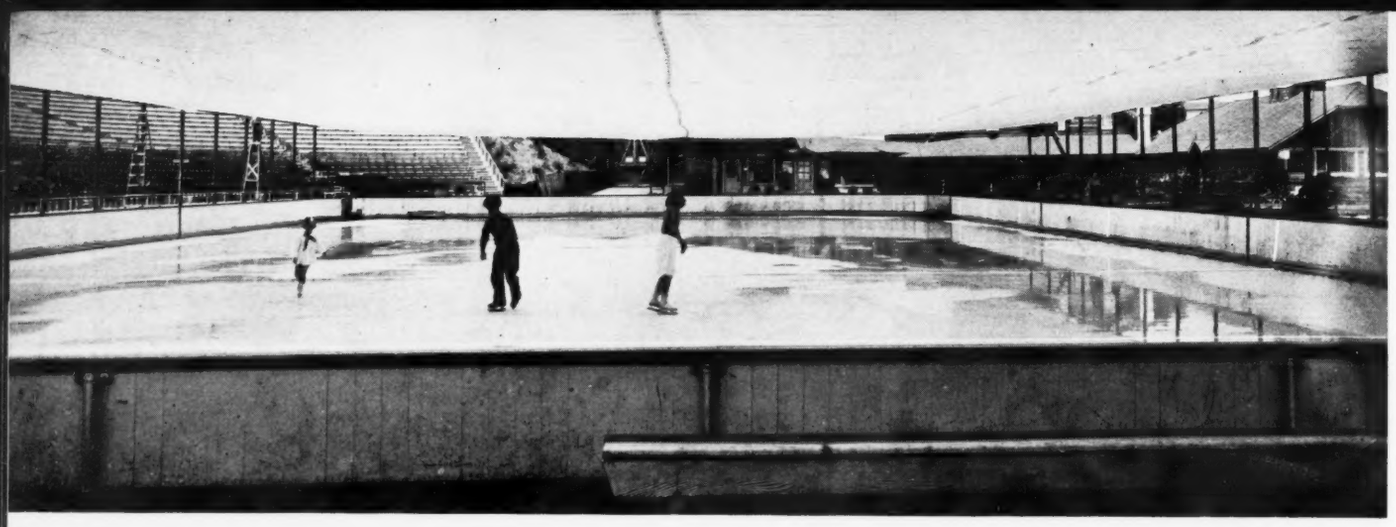
Godchaux's
RESERVE REFINERY

A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs.

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • AIR HEATERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS
FLUE GAS SCRUBBERS

before purchasing Boiler or Fuel Burning Equipment



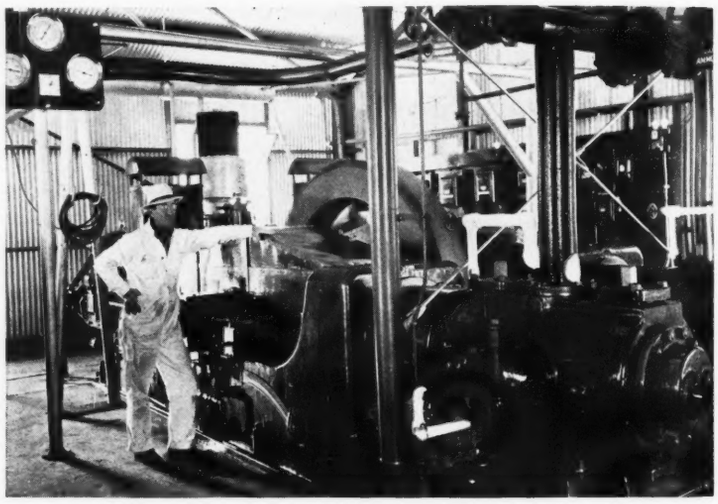
Rink, 100 x 210 ft, operates year 'round. Cloth canopy protects ice from direct rays of Southern-California sun

Skating on Natural Gas

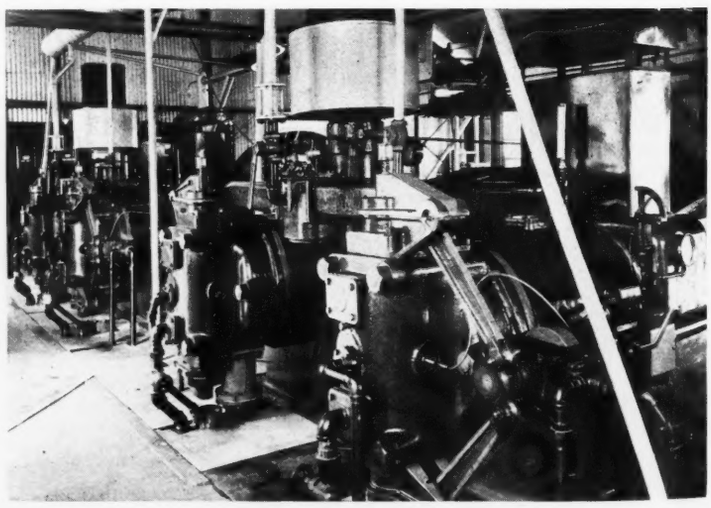
ADMITTING NO DEFECTS in his climate, the Southern Californian points proudly to his "winter sports"—up in the mountains, of course, but also down on the plains. For instance, take these "Tropical Ice Gardens" close by Los Angeles. The big open-air rink in Westward Village operates the year 'round with nothing but a ceiling of gauzy fabric to keep the ice from sunburning.

Of course, it takes a lot of power for refrigeration, but that's easy. Somehow everything seems easy in California. Super-quality, low-cost natural gas comes right out of the soil to make power, which makes refrigeration, which makes ice for the sunland skaters.

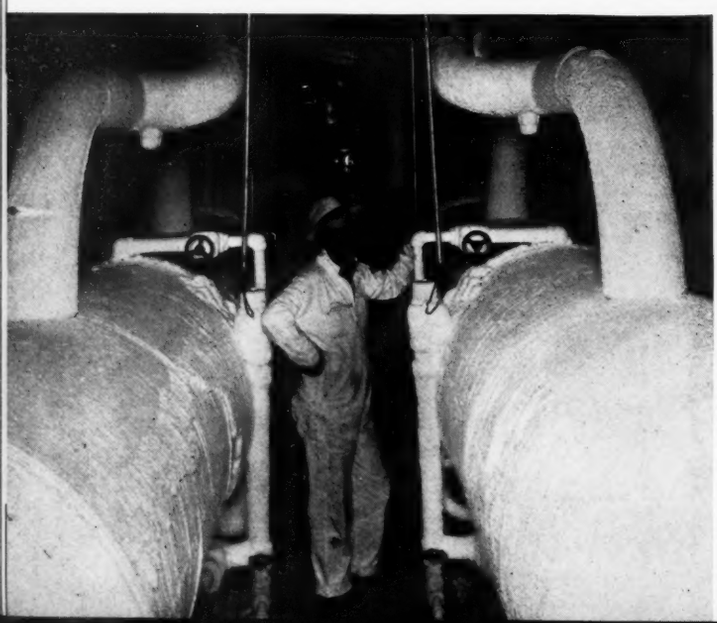
Engineer O D Clem showed his plant to Editor Swain last summer—two big horizontal units producing altogether 400 tons of refrigeration. Each unit is like a rectangle, flywheel at the center, two 100-hp Worthington gas-engine cylinders at the corners of one end, and two Carbondale ammonia-compressor cylinders at the corners of the other.



Chief Engineer O D Clem faces compressor cylinders of one unit (each cylinder has 100 tons capacity)



Two units seen from engine end, showing two pairs of 100-hp natural-gas power cylinders



Clem keeps cool with his brine coolers

THE OPERATING ENGINEER

George Edwards
Advisory Editor

Practical Aids
Maintenance Hints
Questions — Answers

Published monthly as an integral part of POWER

NO ONE COMPLAINS
About This Heating Plant

On the contrary, this simple, well-designed installation has given trouble-free heat and reduced labor turnover at Pennsylvania Lawn Mower Co

By C C HERMANN

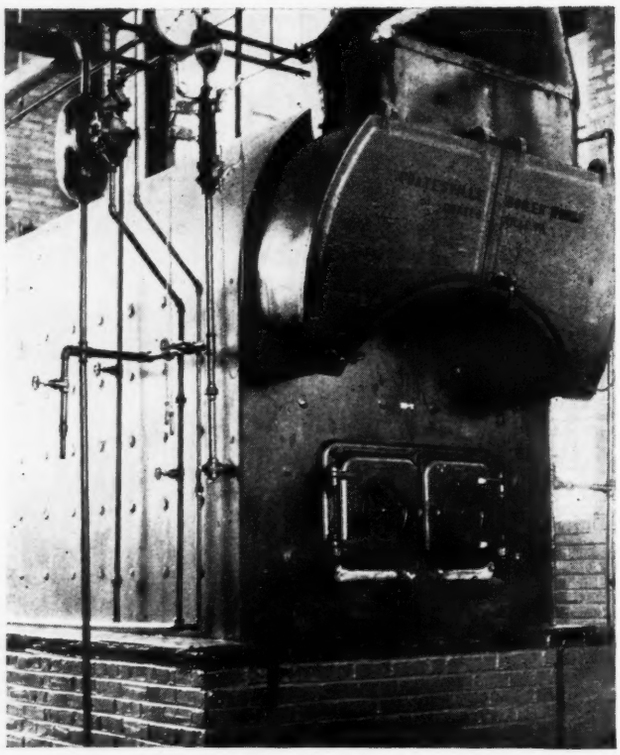
HEATING PLANTS are often like Mark Twain's weather, something that everybody talks about but nobody does anything about. Make it "something everybody complains about" and you come a lot nearer the truth in many cases. But that isn't so at the Pennsylvania Lawn Mower Co's plant at Primos, Pa. There a simple, well designed heating plant, kept on its toes by Engineer Haas, makes winter life in the factory that turns out 40% of the lawnmowers made in this country so comfortable that labor turnover has been sharply reduced.

Of recent construction, the factory building covers 150,000 sq ft and is of single-story, brick and steel-sash construction, with sawtooth roof. About 70% of the production building is heated from a boiler house near the middle of the line of buildings, making the steam distribution system fairly simple. The longest run of steam piping carries about 600 ft to the office at one corner, diagonally across the plant from the boiler house.

The company buys all power from the local utility system and the boiler house only supplies the heating system and some small process needs. The other principal power service is compressed air; electric motors drive the compressors.

The high boiler-house roof gives

This boiler house heats the plant that turns out 40% of U. S. lawnmowers



One of two high-set, oil-fired, horizontal tubular boilers. Burners are at rear, fire doors are closed off with refractory brick

ample headroom and it hasn't been wasted. The two Coatesville horizontal tubular boilers have good high settings and for good measure the oil burners are set in pits. These S T Johnson units are installed in the end of the combustion chamber opposite the fire doors, bringing them under the extended boiler drum. Fire doors were closed with refractory brick laid so that it can be removed from the door opening for repairs to the combustion chamber. Setting the burners this way gets rid of a cold spot toward the front of the shell over the fire doors and keeps free oil from entering the tubes by making sure that combustion is complete in the combustion chamber. No ordinary bridge wall is needed since the burners are angled enough to strike the brick wall of the combustion chamber at one side. A steel stack 125 ft high provides ample draft.

Low Labor Cost

Part of the economy of this installation comes from low operating-labor cost. Engineer Haas points out that by using oil, with adequate controls, it is only necessary for his man to tend the heating plant one hour out of eight, putting the balance of his time on productive work. By getting back nearly all condensate, boilers stay clean longer and time between cleanings can be spread to about 6 months. All in all, only one manhour of attendance per 8-hour shift gets charged to the heating plant—not bad.

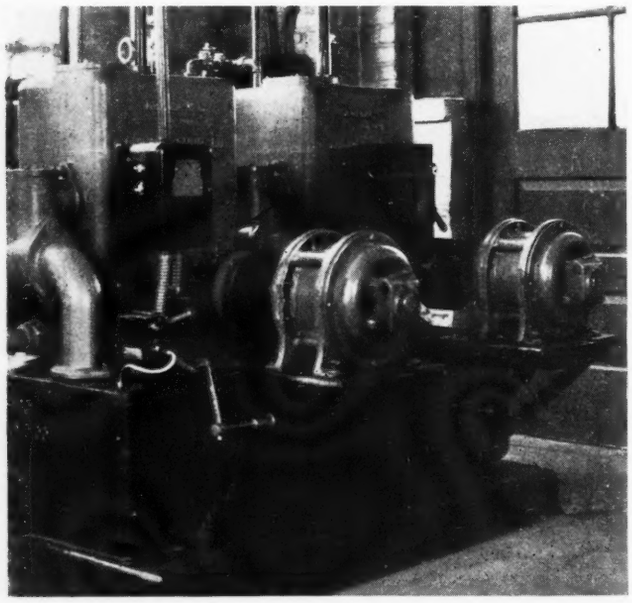
Steam at 5-lb g goes to unit heaters in the factory and direct radiation in the offices. During spring and fall, and when occasional mild winter days come along, pressure is dropped to 2.5 lb.

Unit heaters, of 125,000-Btu-per-hr capacity, hang from the roof trusses about 10 ft above floor level. All are equipped with adjustable deflectors to direct the air stream as desired, and all face the outside wall area. This means that warm air from the heaters offsets cold infiltration around the sash and makes work spaces along the walls as comfortable as those in the middle of the room. No more kicks about cold corners! Another dividend from aiming the heated air at the windows comes from keeping the glass free of frost and thus making the most of natural light during winter days.

Covered overhead lines, easy of access, carry the heating steam to various parts of the plant. Far ends of the branches are trapped to remove condensate. All radiators are equipped with traps and all drips are piped back to the boiler room to the vacuum-return pumps. Two of these Condo-Vac units, rated at 40,000 sq ft each, with 5-hp motors, eliminate air in the return system and discharge directly into the boiler. Water level is regulated by a McDonnell water-level control.

Appearance gains a lot from color-coded piping, but biggest gain is in better and faster operation and maintenance. The color tells the story! Oil lines are covered and painted white. Steam lines, both bare and covered, get brown paint, while all condensate-return lines are aluminum-coated. Blue paint spots cold-water lines and red means sprinkler piping.

Thermostats keep plant temperatures within comfortable limits; locking devices on the units prevent unauthorized persons from tampering with the settings. Considerable care went into the location of the thermostats so that desired temperature conditions are obtained regardless of outside temperature and wind conditions. With 110-volt single-phase motors on the unit heaters it was possible to cut in the thermostats directly on the motor-operating circuits so that the fan motor is started or stopped by thermostat action, directly. It makes a simple control setup and yet takes care of local differences in exposure to sun, wind, etc. Engineer Haas says this scheme suits conditions at Pennsylvania Lawn Mower to a T.



Motor-driven vacuum pumps keep the return system free of air and discharge into the boiler under water-level control

We Need **APPRENTICES!**

What is being done to make sure our plants will run right this year, next year, ten or twenty years from now. The answer is, not enough. Here's a problem power men must face and lick before long

By PHIL SWAIN
Editor of POWER

IN MY OPINION, every engineer should be first of all a good mechanic. The designing engineer should be a mechanic, so he can design things easy to build and operate. The research engineer should be as handy with a file as with a microscope. Even the college professor of engineering thermodynamics or descriptive geometry will be a better teacher if he is a good mechanic as well as a good theoretician.

You may or may not agree with these examples, and I don't particularly care whether you do or not, for the power-operating job is what I'm really going to talk about. I don't think any reader of this "Operating Engineer" will disagree with me when I say that every man concerned with plant operation and maintenance, from chief down, should be a good mechanic.

You older men who have come up through the school of hard knocks know that the bottom rung is the place to begin climbing the engineering ladder. You know that the fellow whose devoted friends start him on the middle rung is likely to get dizzy and fall off when he gets to the top.

Some months ago a lady out in my home town on Long Island was telling me about her son, recently out of college. He went to work for some big concern. They put him on menial jobs for six months. "But now," she said, "he has his own private office with his name on the door." She thinks that's wonderful. I think it's horseradish!

If I were starting life again and looking for my first industrial job I wouldn't take a position unless it were dirty, and unless my prospective boss agreed to keep me in the dirt for at least three years, shifting me around from one greasy task to another, as fast as I learned the ropes.

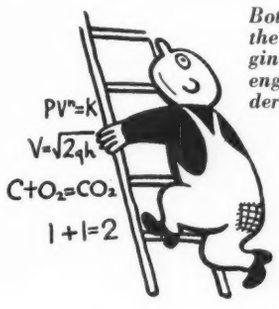
Of course, I've got to admit there are depression times when a young fellow must take what he can get, but a mighty good slogan for most young fellows today would be this: "If a job isn't dirty, don't take it."

Any industrial man who can't think with his fingers is only half-educated. One of the troubles with a lot of American industrial establishments is too many bosses who don't understand the jobs they're bossing. It makes for bad management, bluffing, buck-passing, lack of respect—also for a plant dying on its feet because its head is in a muddle.

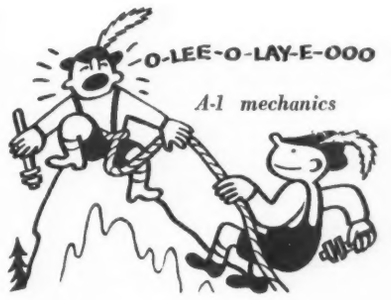
Take the other side of this picture. I think the chief reason certain industries are going places is that their big bosses know what it's all about. Don't imagine that the great success of the automobile industry is based entirely on smart selling (although there's plenty of that). Cars are sold in great quantity because they are cheap. They are cheap partly because they are sold in great quantities, but even more because there is a lot of mechanical horse sense behind the production line.

The plants are full of good mechanics. The foremen and production superintendents are good mechanics, and right at the very top (in such positions as board chairman, president and vice-president) are such A1 mechanics as Henry Ford, Walter Chrysler, William Knudsen, and so on. It's something to think about.

All of which is by way of introduction. Industry's industrial power chiefs



Bottom rung is the place to begin climbing the engineering ladder



are getting older. Young fellows are working up the line, or should be. What are we doing to make sure that every subordinate can handle his own job, also the other fellow's in a pinch, that he can keep things in shape, maintain them, fix them when they break, handle himself in an emergency?

In short, what is being done to make sure this plant of ours will run right this year, next year, ten years from now, or twenty? What is being done to make sure that today's young men have the chance they deserve (that some of them deserve)?

The answer is, "Not enough." Human inertia stands in the way. Many chiefs just let man training go by default. Others are actually afraid to have really competent men working for them (what a reflection on the boss!). In some districts the labor unions have put repressive limitations on the selection and training of men.

I see many signs that the times are ripe to give this matter some honest attention. Because of a threatened shortage of skilled mechanics, all industry is now thinking about the problem of apprentice training. The U. S. Government has set up a federal committee to study the matter.

Last summer, out in San Francisco, Chief John Herzog, of St Mary's Hospital, told me that power men must face this problem and lick it. Now he writes me along the same lines.

"Under an apprentice training plan," says John, "young men are given broad

Afraid to have competent men working for them

training in all branches of skilled occupations. The apprentice learns while he earns. He works under qualified and sympathetic journeymen and foremen, under real working conditions. The apprentice works with the materials, tools and equipment used by the journeyman. He also attends a trade school for the practical and technical instruction to supplement his job experience.

"Apprentices will not displace skilled chaftsmen now employed. Planned apprenticeship is within the control of the industry. Additional employees will increase only in proportion to the needs.

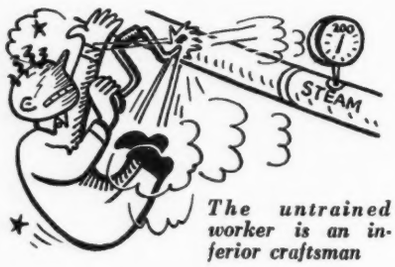
"A sound program of apprentice training definitely reduces labor turnover. The worker will be more versatile and capable of meeting shifting demands. The untrained worker is an inferior craftsman, and therefore, a liability. He makes it expensive and difficult for the employer to deliver satisfactory work. Apprenticeship means financial gain for the worker, employer and the public.

"The average age of a skilled craftsman today is over 45. Industry must therefore take the initiative and plan for an apprenticeship training program or face a serious shortage of skilled workers in the future.

"Apprenticeship has been successful in the past in European countries. The fact that many of our best craftsmen are foreign born, and had apprentice training, indicates the validity of this assertion. It can be made to work in the United States of America, and by American methods.

"Trade employer and employee organizations can start apprentice programs by appointing apprentice committees to work with educational authorities. These committees plan the work program so that the apprentices receive definite training on the job, and arrange with the trade school for the technical phases of the trade which the apprentices need.

"The apprentice is given the opportunity to learn all phases of the trade. It sometimes requires shifting him around so that he will get all-around experience. The employer must be sure his chief engineer is sold on the plan, as the foreman can 'make or break' an apprentice.



The untrained worker is an inferior craftsman

"The union or other employee organization also has a responsibility. It should encourage and help apprentices to learn the trade. It should make sure they get an opportunity to receive all-around training. It can make certain that the apprentice lives up to his side of the agreement.

"Something must be done for our sons, to give them a start in life, take them off the streets and give them the opportunity to learn a trade."

I am one hundred per cent in accord with John Herzog in the matter of giving today's young men a more thorough mechanical training. As to the exact method of accomplishing this, as far as organization is concerned, I reserve judgment. Let's have some argument in the "Corner." Let's find out what the readers of "Operating Engineer" think.

Do you feel that mechanical training is a fundamental requirement for any power-operating job up to and including that of chief? Are we training young men as we should? If not, what ought to be done about it? What is practical under existing conditions? Speak your mind!

How to Repair Cracked Diesel-Piston Heads

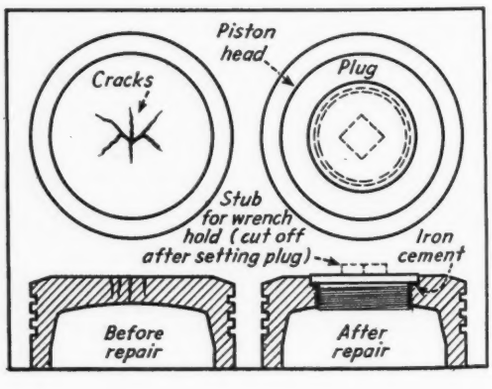
By **VREELAND TOMPKINS**
Smooth-On Mfg Co

THE very high temperatures and extreme temperature variations that occur within cylinder heads of internal-combustion engines, particularly diesels, often impair vital parts surrounding or close to the combustion chamber. A common trouble with cylinders of larger-size diesels is burning out of piston heads.

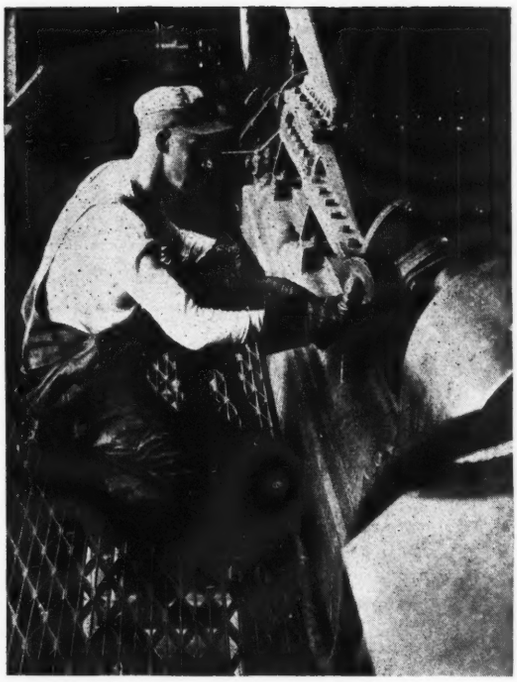
In severe cases, not only may some surface metal burn away like grate bars in a furnace, but shrinkage cracks develop and grow with use until they weaken the piston, or even extend clear through the head metal. Final result may be that part of the force of the explosion or combustion passes into the crankcase. Then the engine becomes unsafe, or at least inefficient.

Cracks and burning of metal in their earlier stages are almost always confined to the center of the piston-head surface, ruining this part of the piston, but leaving the rest perfectly sound. Where this has happened, a practical repair that restores initial piston strength and saves over cost of new pistons, can be made as shown in the sketch.

Weakened head metal is turned out in a lathe and the bore of the opening so formed is threaded to receive a threaded plug which may be cast and finished to produce a metal thickness equal to that of the metal removed. The plug is cast with a top stub for wrench hold; so it can be forced to a tight fit after the threads have been coated with iron cement, and a pad of iron cement in the form of an annular ring has been placed between the collar on the plug and its seat, see sketch. After forcing the plug to a tight fit, cut off the stub to leave a smooth surface.



The writer first saw this repair used in a New Jersey shop where six 14-in. diesel pistons were in the same bad condition and all were being successfully reclaimed by this method.



WHY the Heck BLOW that DUST Around

By B A BRIGGS
Philadelphia, Pa.

Fig. 1—Corners and crevices that collect dirt can be easily cleaned by vacuum

CLEANLINESS has been classed as being next to godliness and nowhere is this more true than in the power plant. A poorly operated plant is generally dirty; conversely, clean plants are usually efficient. And, you can add to this the fact that when you do a good cleaning job, you find the little defects before they have time to develop into big troubles, costly shutdowns and repairs.

The cleaning job involves several factors, from removing loose dust to hardbaked deposits. The former can be cleaned up in several ways: by wiping, by compressed air and by vacuum cleaning. Compressed air has been used extensively, but it only blows the dirt out where it can be wiped up. But why blow the dirt around when it can be removed by vacuum without creating a dust nuisance.

Vacuum cleaning can be applied to practically all jobs around the power plant, some of which can't be done in any other way. Coal dust is not only a nuisance but also an explosion hazard if blown into the atmosphere, which can be avoided by sucking up the dust.

Many places the careful operator wants to clean, such as pipelines, tops of boilers, etc, are difficult to reach and are in high-temperature zones. Add to these difficulties the dust cloud created by compressed-air cleaning, and you can understand why many operators avoid cleaning as long as possible. All these troubles can be largely eliminated by vacuum cleaning.

Electrical machinery and similar equipment present many problems. Spaces between armature coils and air gaps between rotating and stationary parts are small. Wiring is often complicated on the backs of switchboards and control equipment, forming many small places for dirt and dust to lodge. If compressed air is used, there is always the danger of blowing moisture into the insulation. A strong blast of air can also injure the insulation.

I know of cases where attempts to blow dirt from air gaps of induction motors has packed the dirt in solidly between the rotor and stator with the result that the dirt acted as a brake and overloaded the motor. Then, the only thing that could be done was to dismantle the machine and scrape off the dirt. Vacuum cleaning will not pull the gummy material from air gaps and similar places, but it will remove all the dry dust without danger to insulation. The part that cannot be removed in this way is left undisturbed and later taken off by scraping or by washing with a solvent.

Vacuum-cleaning equipment is available for power plants in many forms, such as stationary systems piped to a convenient outlet, portable units that can be moved from one place to another, and small outfits for doing light cleaning, Fig. 2, that can be carried about. I have known several operators, without money to buy new equipment, who salvaged old units from junk yards or second-hand shops and fixed them up. Results were so good that they were able to get the management to buy new and more efficient equipment.

To put it briefly, why in hell blow the dirt around when you can suck it in.

Fig. 2—Lightweight, motor-driven, easily carried vacuum cleaner is a handy tool

PRACTICAL AIDS TO OPERATION

Tough Filing Job Made Easy

EVERYONE THAT HAS TRUED UP elevator-guide-rail joints with an ordinary file knows that it is not an easy job and has probably come out with some skinned knuckles. We use a mounting for the file with a handle at each end (see photo). The two handles are supported on a piece of spring steel to which the file is attached at each end with a couple of screws.

A turnbuckle *T* between the two handles is used to pull the two handles toward each other in such a way that the spring steel support and the file are bowed slightly outward at the center. This tool has taken most of the grief out of truing up guide rails and the job can be done much faster and easier, without danger of injuring the hands. The men who use this file swear that it is the long-awaited answer to an elevator-mechanic's prayer.

New York, N. Y. WILLIAM DEVAUGHN

Don't Neglect Gages for Low Pressure

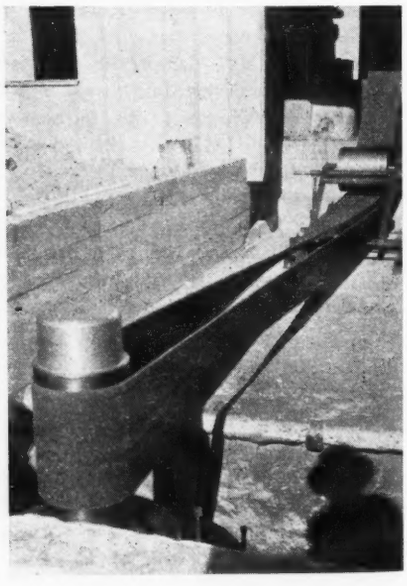
ACCURATE PRESSURE-GAGE READINGS are very important for safe and efficient operation of power plants. In many cases, operators have a tendency to give high-pressure gages attention and let the low-pressure ones look out for themselves. An experience in our plant taught us a lesson.

A gage on the low-pressure exhaust line from our turbine read low and was not discovered for some time. Because of this, we were operating the turbine against about 2-lb higher back-pressure than necessary, which increased its steam rate considerably. This little experience brought home the necessity of checking all pressure gages at regular intervals. For economical operation, this is more important on low-pressure than on high-pressure gages.

Richmond, Va. O M ROBERTS

Quarter-Turn Belt Solves Difficult Drive

A FEELING EXISTS among power-application engineers that quarter-turn belts should be avoided if possible. The photo shows an arrangement of this drive that we have used successfully many times. This belt connects a 185-hp diesel engine, with a 78-in. flywheel, to an 11-in. pulley on a vertical deep-well pump, making the pulley-diameter

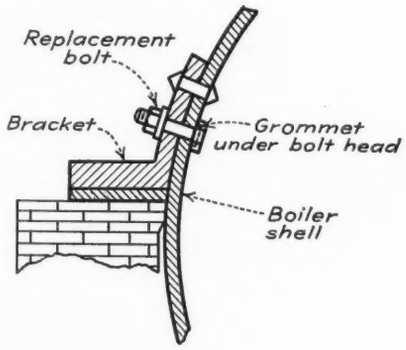


ratio 7.1 to 1. The belt is endless rubber, 14-in. wide by 75 ft. long. At top engine speed, 257 rpm, a belt speed of 5250 fpm results.

A single-pulley track-type idler with automatic compression-spring, belt-ten-

sion control and cross-single adjustment to hold belt on when running backwards, guides the belt and maintains tension.

Los Angeles, Calif. HARRY M PERRY



Bolt Replaces Rivet

A HEAD SNAPPED OFF a rivet holding a cast-iron support to the shell of an old hrt boiler and a leak started around the rivet. We were afraid to replace the rivet with a pneumatic gun riveter as we might crack the cast-iron support, so did the job with a bolt and nut, as in the figure.

After removing the rivet, we reamed the hole to a good surface. Then, after selecting a bolt slightly larger than the hole, we turned it down to a good driving fit, making the diameter of the threads slightly smaller than the bolt body. We cut a recess inside of the head and filled this with red lead and candle wicking to serve as packing to prevent leaks. A soft steel washer under the nut permitted it to be tightened onto the bracket without danger of cracking the casing.

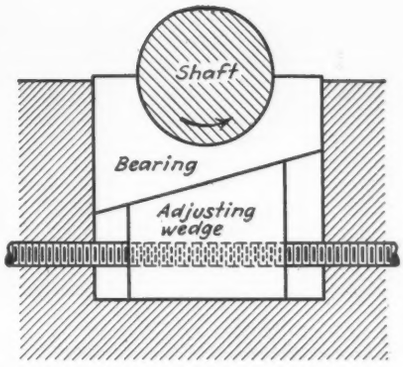
Cleveland, Ohio. A C WIGGINS

Reversed Rotation Causes Hot Bearings

WHEN A GOVERNOR FAILED on a diesel engine driving a reciprocating pump, the flexible coupling parted and the engine wrecked itself by overspeed. The only replacement, nearer than the engine builder, was a similar unit in a nearby pipeline station, which we bought.

We found that the engine ran counterclockwise, while the original one operated clockwise. The camshaft of the first unit was not damaged so we installed it in the replacement unit to reverse its rotation, care being taken to reverse the splash pins on the connecting rod bearings so that they would dip into the oil in the right direction.

Despite careful adjustment, the main bearings on the new engine gave trouble. Finally we traced the trouble to the adjusting wedges under the main bearings.



These wedges were set originally with the thick edges away from rotation as in the figure. When we reversed the shaft rotation this condition was reversed also.

Reversing the wedges with their accompanying adjusting screws and bottom half bearing, and then scraping the bearings to a proper fit, cured the trouble.

Longview, Texas M T PATE

Double Safety for Lighting Unit

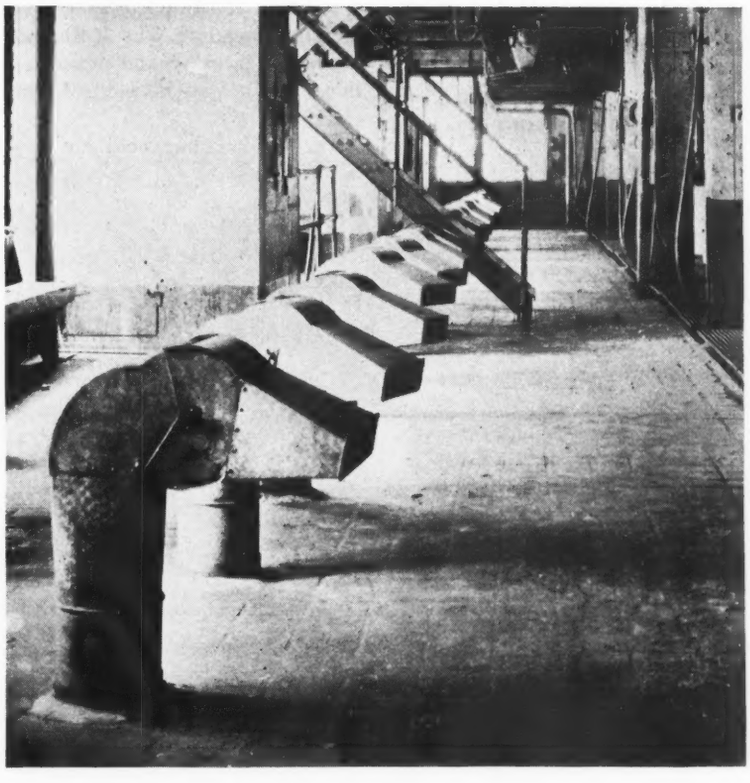
WHEN ELECTRIC LAMPS are used around food products, great care must be taken to prevent glass getting into the food if a lamp breaks. For illumination in our sugar bins, we developed a

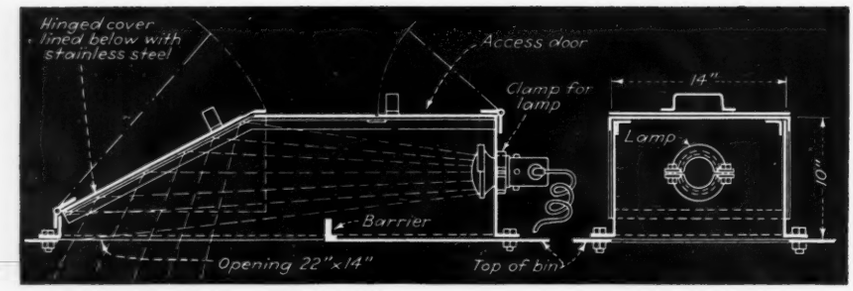
Adjustable Air Nozzles Condition Sugar Plant

THE HOT CENTRIFUGALS in our sugar mill discharged vapor into the faces of operators. This discomfort was reduced by attaching an induced draft fan to a header with connections to the curbs of the centrifugals. To increase the capacity of the fan, a jet condenser was inserted in the header just in front of the fan suction. In addition, an overhead ventilating pipe forced fresh out-door air through nozzles against the backs of the workmen. Discharge from the nozzles was a mixture of fresh air plus that drawn from the room near the ceiling.

We found that the air temperature at the ceiling was from 10 to 15 deg higher than at the floor. To reduce temperature of the resulting mixture, we put the fresh air main under the floor and connected it with individual adjustable ball-and-socket nozzles above the floor (see photo). Each operator can now direct the ventilating air to suit his own comfort.

Philadelphia, Pa. NEWT SMITH
Pennsylvania Sugar Co





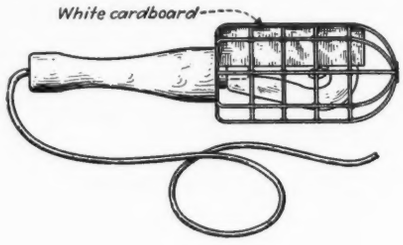
lighting method, shown in the figure, that is doubly safe. A special safety lamp totally inclosed behind a reflector is supported in a box above the bin, as in the diagram. Light from the lamp is reflected down into the bin by a sheet of polished stainless steel on the box cover.

At its bottom, the box is about 36 in. long and is bolted directly to the cover of the bin. Under the reflector, a hole 14x22 in. is cut in the bin cover to permit light to be reflected onto the sugar. This leaves about 20 in. of cover in front of the lamp to catch glass if the lamp is broken. A barrier at the edge of the hole prevents glass from flying off the cover. We feel that this arrangement is just about as safe as it is possible to make it. First, the lamp is so protected that there is only a very remote chance of it being broken. If this should happen, the glass cannot fall into the bin.

Philadelphia, Pa. ALEX IRWIN
Pennsylvania Sugar Co

A Light Glare Guard When You Want It

EXTENSION LAMPS used in power-plant maintenance work are seldom equipped with reflectors. In fact, among the widely diversified illuminating jobs which these lights are called upon to do, there are many where a device of this kind, permanently fastened on the inside of the guard cage, is a distinct nuisance. On the other hand, there are places where reflectors are desirable. In such cases, in our plant we slip a piece of bright white cardboard temporarily



Dry Ice Turns the Trick

DRY ICE IS FINDING an ever-increasing number of jobs in the erection and maintenance of power equipment. We were faced with the problem of removing the brass valve seats from a boiler-feed pump. An 8-ft handle on the wrench and plenty of man-power failed to start the seat. Then we placed dry ice on the valve seats for a few minutes, after which they were sufficiently contracted so that one man could remove them with a 2-ft wrench.

Rochester, N. Y. W P KING

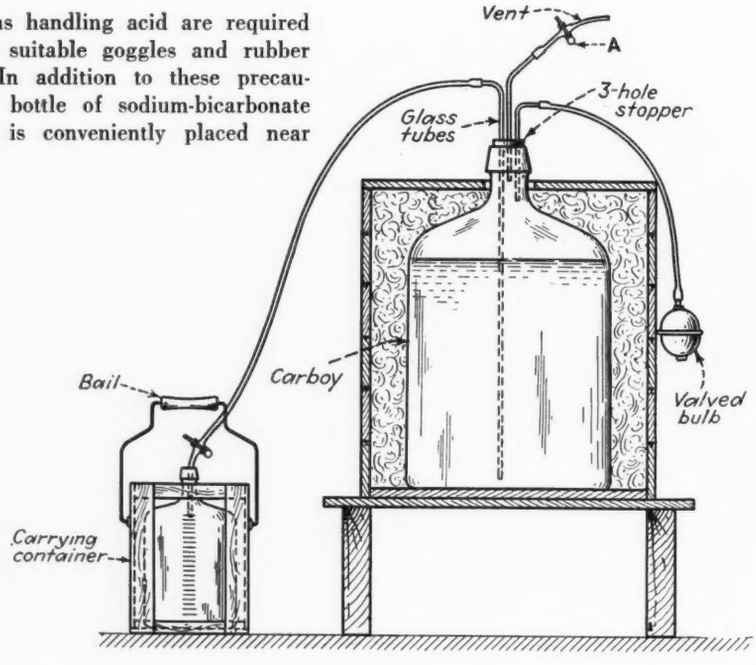
Safe Handling of Feedwater Chemicals

BOILER TROUBLES that might result from impurities in our feedwater supply are prevented by pumping chemical solutions directly into the feed drums of each steam-generating unit. The acid is received in wood-encased glass carboys, stored in a safe place and dispensed in varying lots of from 2 to 8 lb whenever a fresh batch of water-treatment solution is mixed. To simplify removing acid from the carboys and its transportation to the solution mixing tank, we have worked out a procedure that combines both minimum time and maximum safety of personnel.

To eliminate manual handling of cumbersome carboys when transferring acid to easily carried containers, a syphon arrangement is used, as in the figure. This consists of 3-hole rubber stopper, suitable glass and rubber tubing, pinch cocks and a valved rubber bulb to produce enough air pressure above the surface of the liquid to start the syphon. Pinch cock *A* is closed when pumping up pressure and opened when syphoning action begins. The carrying container is a 10-lb bottle protected against breakage by a wooden frame that is equipped with a bail to facilitate handling. The bottle itself is graduated in one-pound divisions, with lines and figures painted on its exterior.

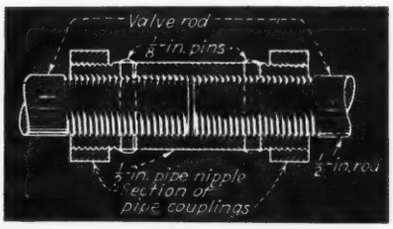
Persons handling acid are required to wear suitable goggles and rubber gloves. In addition to these precautions, a bottle of sodium-bicarbonate solution is conveniently placed near each transfer point to be used as a neutralizing agent in the event acid comes in contact with the body. Danger of anyone beneath the grated stairs being burned by accidental dropping or overturning of the carrying container during its transportation to the mixing-tank level is guarded against by temporarily segregating the hazardous area. This is done with light-weight chains carrying danger signs stretched between hooks strategically located in building structural members and walls.

Roanoke, Va. S H COLEMAN



inside the guard cage of the extension lamp (see drawing). This makes a satisfactory substitute reflector.

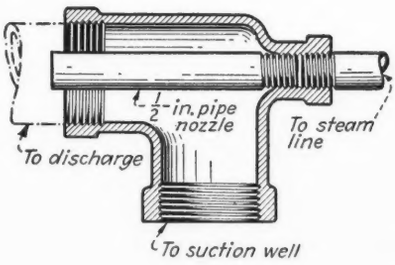
Lynchburg, Va. O M ROBERTS



Pipe Nipple Repairs Broken Valve Rod

A VALVE-STEM ROD on one of our ammonia pumps snapped. A new rod was not easily obtained so we repaired the old one as in the diagram. For the coupling on the rod we screwed a coupling onto each end of a short ⅜-in. pipe nipple. With a hacksaw we cut through the couplings and nipple, leaving ⅜ in. of coupling on each end of the nipple to serve as reinforcing rings. Then we threaded the nipple on the inside and also the ends of the broken rod, and assembled them as in the diagram. Finally, we drilled through each end of the coupling and riveted in a ⅛-in. pin. This made the rod as good as new, for the repair has now been operating for several years.

Riverdale, N. Y. ALEX GRAY
Chief Engineer, Colored Orphan Asylum



Homemade Ejector A Handy Pump

WE HAVE A HOMEMADE EJECTOR in our plant that is very handy for doing odd jobs of pumping. It is made from a 1½- x 1½- x ½-in. pipe tee, as in the figure. A piece of ½-in. pipe screwed inside the tee serves as an ejector nozzle. On the outside, a ½-in. nipple has been screwed into the tee for connecting to a steam or compressed-air line for operating the ejector. The connection to the ejector can be made any convenient way. In some cases, we have connected the nozzle to a steam line with a hose and the discharge to another hose, then threw the ejector into the water to be pumped and turned on the steam.

Riverdale, N. Y. ALEX GRAY
Chief Engineer, Colored Orphan Asylum

Tips on Operating Portable Conveyors

MAINTENANCE OF PORTABLE CONVEYORS, used for handling coal or other material around the modern industrial plant, is frequently neglected. Being portable and in use a great part of the time, it is difficult to schedule exact times for inspection and repair of these conveyors. But with a little cooperation between the operator and the maintenance crew, it can be arranged.

In our plant, where several portable conveyors are in service, a motor-and-belt-maintenance man is required to inspect each conveyor once a month. Sometimes there will be several days or perhaps a week's difference in the schedule and no fixed date or time is given. On these inspections a check of the entire unit is made, including the motor and general condition of parts likely to wear.

Any necessary minor repairs or adjustments are made. These include replacement of a grease cup, tightening loose nuts and bolts on the frame, etc. Repairs which might take too long or require the help of another man are reported to the office. Arrangements are then made so that the work can be done when least interference with conveyor use will occur. A record is kept of these monthly inspections and of any work done on the conveyor.

In addition to the monthly check up and inspection, each conveyor is brought into the repair shop for a general overhauling approximately once a year. At this time, the motor is taken off the frame, thoroughly cleaned, dried and the windings given a coat of good insulation varnish. New brushes are installed and the commutator cleaned and undercut if necessary. All bearings are cleaned and the lubricant renewed. All mechanical parts are checked for wear or signs of weakness, and if any part looks doubtful, it is replaced. Everything is done to put the conveyor in good working condition and to make it give reliable service for another year, with a reasonable amount of attention.

Sayreville, N. J. K B HUMPHREY

Welding Fixes Lifting Magnet

WE EXPERIENCED quite a bit of trouble with the bolts in our lifting magnets coming loose, because of the vibration to which they were subjected. Loosening of the bolts caused the air gap at the bottom half of the magnets to be rather uncertain, which interfered with their efficient operation.

To overcome this difficulty, we welded the top half of the shell to the bottom, as in the photo. This practice has proved very satisfactory and we have applied it to all the lifting magnets in our plant where we have had trouble with loose bolts.

Latonia, Ky. DANA GIBSON

READERS' PROBLEMS

Questions for Our Readers

Lubricating Steam Engine

Question 1

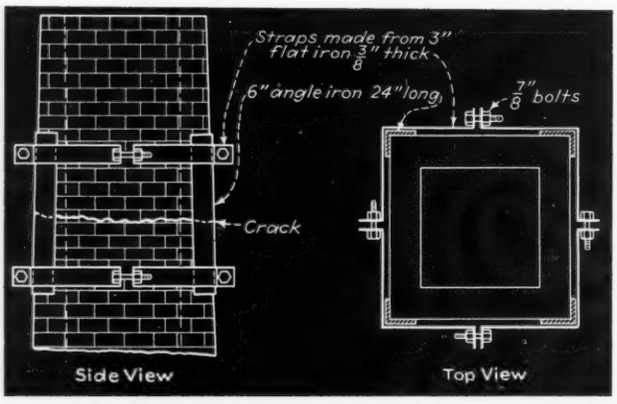
When operating a steam engine fully loaded, a mineral oil gives best lubrication results and can be easily separated from the exhaust. At light loads, condensing steam tends to wash oil off the cylinder walls. Under these conditions, a compounded oil seems to work better, but is harder to separate since part emulsifies. Can POWER *readers tell me the best compromise solution for engines working at highly variable loadings, and where oil in boilers is to be avoided?*—FSP

Keeping the Charge in Pump Air Chamber

Question 2

THE TENANTS IN OUR BUILDING *complain of hammering and jarring in the house-service water lines, served by a duplex steam pump. The pump is fitted with an air chamber, but it seems to lose its charge. What is the remedy?*—JGW

SUITABLE answers from readers will be paid for if space is available for publication. Answers accompanied by practical drawings or photographs will command additional pay.



Repairing Cracked Chimney

Answers to Oct Question 1

The Question

WE HAVE A BRICK CHIMNEY *with a 36 x 36-in. flue about 70 ft high, which shows a crack all around the outside about 5 ft from the top. Can the chimney be made safe by pointing up the crack and placing iron staves at the corners or should the top be taken down and rebuilt?*—CCD

Repair with Straps

I THINK THAT CCD can do a good and safe job by following the accompanying sketch. He should, of course, first point the crack. This repair will not interfere with plant operation, which may be the case if he rebuilds the part above the stack.

Toronto, Ontario. J M FARRUGIA

An Actual Case

I HAVE SEEN only one attempt at mending a cracked brick stack by banding. This attempt, made on a round stack 178 ft high and 8 ft inside diameter, was only partly successful. The crack, and later cracks, were vertical, and were caused by firing of large quantities of dynamite in a nearby quarry.

Three bands, ½ x 4-in. iron, were first put on the stack. As other cracks developed, more bands were applied. During a period of 10 years, during which the quarry shots continued, 18 bands were put on. In the winter of 1932-33, the top of the stack began to tilt over the power house.

Then, engineers built scaffolding up the outer surface of the stack, and without taking it out of service, ripped off and rebuilt the top 20 ft. Three more bands were applied just below the storm top, bringing the total to 21. By 1938, distintegration of the stack forced building of a new concrete stack, and the "old junk pipe sticking up in the air" was razed.

Marissa, Ill. GEORGE BLUM

Suggests Rebuilding

THE QUESTION DOES NOT STATE whether the stack is single- or double-shell. I assume the latter is true, and if the inner brickwork is also cracked, I suggest taking the top of the chimney off from the crack up, and then going two bricks lower. Then, rebuild and point the entire chimney.

It is very important to use proper type of brick and mixture in chimneys. Bricks for the outer shaft should be hard-burned, close-grained; those for the core should be second-class firebrick. Outer brickwork from the foundation up to a plane where winds will have a fair sweep against the chimney should be set in lime-mortar, well strengthened with cement.

Upper portion of the chimney should have a certain resiliency to offset the stress of high wind pressure, and this is best secured by using lime mortar containing a smaller admixture of lime. Proportions for the lower part are one part cement, three lime, and eight sand. For the upper part, proportions are one part cement, two parts lime, six sand.

Since sand does not cling tenaciously to hard, smooth surfaces, more cement should be used with hard bricks. The core should be laid with pure lime mortar or fire clay. Cement mortar should not be used for any part of the core because it disintegrates in the presence of CO_2 and high temperatures.

Philadelphia, Pa. W T MULLEN

Recommends Testing

IN ASSUMING THAT THE CRACK in the chimney is visible from the ground, it is also possible that a closer inspec-

tion will reveal other signs of disintegration which will influence the decision. Hair-line cracks in the joints indicate a breaking of the bond between plaster and brick; once the bond is destroyed, the crack gradually widens.

Very often the extent of damage is more than appears on the surface, and it is only after a thorough inspection that the true condition can be determined. It is possible that in this case moisture has entered the crack and become absorbed by the plaster between the bricks, in which case rapid disintegration takes place and real trouble begins.

My suggestion is to test the chimney and it is my guess that it will be considered advisable to take down the top section, and rebuild. A smoothing tool used at the joints adds considerably to prevention of moisture penetration at the joints. I feel sure that CCD will be better satisfied by rebuilding than by supporting the top by iron staves.

Ansonia, Conn. W T ESTLICK

Reduce Head Pressure?

Answers to Oct Question 2

The Question

AT ONE OF OUR FISH-FREEZING *and storage plants, condensing pressure is kept at 135 lb in preference to lower pressure, which could be had without additional cost. Better freezing time is claimed or there is some other benefit that I do not know about.*

We have 5 freezers (shelf coils, hand expansion valves) on the same floor level as our electric-driven vertical enclosed ammonia compressors. The power rate is 2¢ per kwhr and we have all the 55-F water we care to use in our condensers, which are plenty large. Backpressure is held at from 5-in. Hg vacuum to 5-lb pressure. It seems that it would be more economical to drop our condensing pressure to 90 lb or so. What do POWER *readers think?*—MC

High Pressure, More Power

If MC's statement is true that lower condensing pressure in his plant can be obtained without additional cost (water always costs something if only the cost of pumping), he can improve both the economy and the efficiency of his plant by reducing condensing pressure.

The higher the head pressure, the more power is required, since this pressure must be overcome in moving the piston in the cylinder. Leakage past piston rings and valves goes up with higher head pressure. Re-expansion losses due to clearance spaces are less with a lower head pressure.

The greater the condensing pressure, the higher the temperature of the liquid ammonia. With a lower head pressure, less ammonia would be used in cooling itself to the temperature of the expansion coils.

Paulsboro, N. J. E A DOWNS

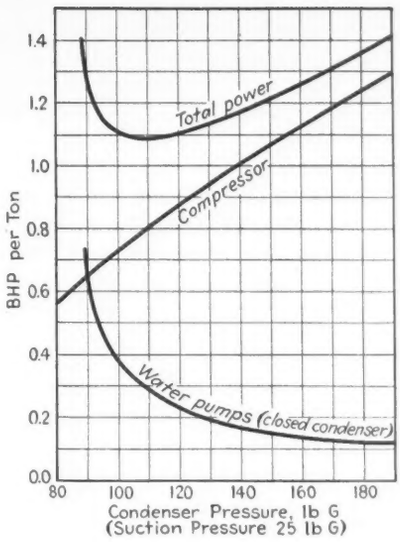
Graph Shows Over-all Power Consumption

THE HEAT CONTENT of liquid ammonia is approximately 108 Btu per lb at 90-lb pressure, and 130 Btu per lb at 135-lb. Assuming that the suction pressures given by MC indicate normal fluctuations, the average suction pressure is 1.3 lb per sq in. g, at which point dry saturated gas contains 603 Btu per lb. Therefore, the net refrigerating effect of one lb of liquid ammonia is 495 Btu per lb at 90-lb pressure, as against 473 Btu per lb at 135-lb. Thus, it is evident that lowering condenser pressure results in a slight, but nevertheless definite, increase in the available cooling effect per lb of ammonia.

It is does not follow, however, that the claim of better results at 135-lb pressure is necessarily wrong, because the capacity of the expansion valves may enter the picture. Rate of flow through any given valve opening depends on the differential pressure across the valve. If the inlet pressure is reduced from 135 to 90 lb g, with outlet pressure remaining unchanged, the valves must be capable of opening nearly 25% wider to pass the same amount of liquid as before.

In this connection, MC might do well to consider that the number of handwheel turns is a very misleading indicator of the actual valve opening, except in specially designed valves. In many cases, the last few turns of the spindle contribute very little towards enlarging the useful valve passage. In this particular case, it is possible that expansion valves may not be large enough to pass sufficient liquid at 90-lb pressure, even at full opening.

As to the economy of operation, it is often taken for granted that lowering condenser pressure saves power. This assumption holds true for the compressor alone, but not always for the system as a whole. A lower condenser pressure, under otherwise equal conditions, must be obtained with



higher flow rates of cooling water, thereby increasing power demand of the circulating pump. This factor is particularly important with closed condensers, because of the rapid increase in friction head caused by increased cooling-water flow. This means that the circulating pump must not only furnish more water but must also deliver this water at higher pressure.

Therefore, the conclusion is that the most economical condenser pressure for the plant as a whole is that at which the sum of the compressor hp and the water-pump hp is at a minimum.

Some years ago, when dealing with this very problem, I made the accompanying graph which shows the power demand per ton of refrigeration of both the compressor and the water pumps in relation to different condenser pressures. Summation of the two curves produces a composite of the over-all power consumption, which supplies the answer to the problem. Because of the number of variables entering into calculations, the curves apply only to the particular plant under investigation at that time, but the same general procedure can be used for any other set of conditions under a similar mechanical setup.

Old Bridge, N. J. A J LUBELEY

Answer is Yes

ONE OF THE MOST IMPORTANT ITEMS in refrigerating-plant operation is to keep condensing pressure as low as possible so that power required for compression is reduced to a minimum. Pressure is kept low by having plenty of cold condensing water and ample-sized condensers. Power required for compression varies directly with the condensing pressure. As stated by MC, there is plenty of 55-deg water avail-

able and since condensers are large enough, there seems to be no reason why a condensing pressure of about 105 lb could not be obtained. The condensing temperature at this pressure is about 67 F.

Assuming 0 lb g pressure at suction, no superheat and no liquid subcooling in condensers, I estimate that, by using average values, the motor input would be about 1.7 kw per ton of refrigeration when the condensing pressure is 135 lb g. If the same assumptions are used for 105 lb, only 1.3 kw per ton of refrigeration would be required for motor input.

If no additional power is required to pump the larger quantity of water needed to reduce condensing pressure to 105 lb g, then the difference between 1.7 and 1.3 kw would be power saved.

At continuous operation and 2-cent-per-kwhr power, this means a saving of about 19 cents per day per ton of refrigeration produced. If MC will determine the tons of refrigeration of his plant and multiply by 19 cents, he will get total power savings per day. From a power standpoint, this figure indicates it is very desirable to operate at some lower condensing pressure.

About the only reason for operating at higher pressure is that liquid-pipe and expansion-valve sizes may be too small to handle the load without excessive friction losses. To take care of these friction losses, it is necessary to have a greater pressure differential between condenser and machine suction than the differential available when condensing pressure is lower.

University, La. G F MATTHES

Maximum Capacity at Minimum Cost

IF A 90-LB HEAD PRESSURE can be attained, by all means do so. Liquid going to the evaporating coils will be about 20 F lower, and this reduced liquid temperature means that less liquid will have to evaporate at the expansion valve to cool itself down to evaporator temperature. Thus, the compressor will need to handle less gas per ton of refrigeration accomplished. This means a power reduction at the compressor for the same tonnage as at the higher head pressure. Also MC saves power at the compressor by carrying a lower head pressure, due to the fact that less work is required of the compressor because less resistance is offered to the piston.

To get the maximum capacity at the minimum cost, operate with a suction pressure as high as room temperature will permit and a head pressure as low as possible. A high suction pressure is desirable because the ammonia gas will have a greater density, and consequently a greater weight of ammonia will be handled in a given time. Also, work done on a gas shows up as heat; thus, more work is required to compress a low-pressure gas to a given discharge pressure than is required to compress a high-pressure suction gas to that pressure.

Toledo, Ohio. L KISHA

Restrictions in Piping

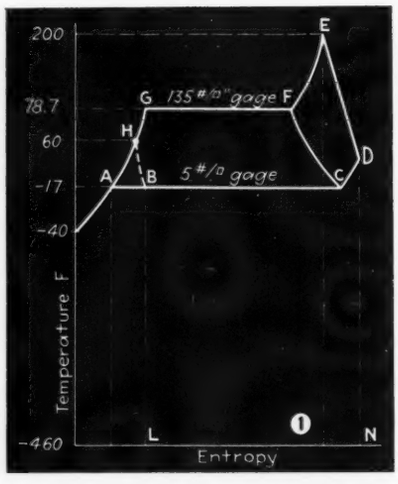
THE BEST WAY TO FIND OUT if freezing time will be increased is to reduce head pressure by 5 or 10 lb steps and note results. If the contention (increase in freezing time) is confirmed, the probable cause is that liquid line is too small or there are restrictions in the piping which interfere with flow of liquid.

Liquid ammonia lines should be of such size that velocity does not exceed 200 fpm. Restriction in the piping may be due to pipe not being reamed when installed, accumulation of pipe dope or litharge in fittings caused by applying the dope to the fitting instead of the pipe threads, or in the case of a welded line, by icicles inside the pipe caused by poor welding.

Rochester, N. Y. JULIUS BRODSKY

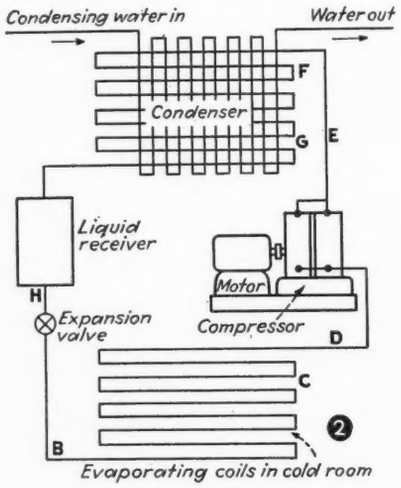
Suggests 100-lb pressure

MC IS CORRECT in assuming that power required would be less if the condensing pressure could be reduced. Ammonia is carried through a vapor cycle which is almost the reverse of a steam power cycle. The temperature-entropy diagram, Fig. 1, gives a picture of the heat changes in the ammonia cycle. Fig. 2 shows the piping diagram, lettered to correspond to Fig. 1. Areas on Fig 1 represent heat quantities. For simplicity, heat quantities radiated to and from atmosphere are neglected.



Liquid ammonit at *H* passes through the expansion valve and about 15% of the liquid flashes into vapor as the pressure drops to 5 lb per sq in. in the freezing coils. The rest of the ammonia is gradually evaporated at a temperature of —17 F, which is the evaporation temperature for this pressure. When it has reached point *C*, the liquid is all evaporated and the vapor continues to absorb heat until reaches point *D*, where it leaves the coils as superheated ammonia to go to the compressor. The vapor is now at say, 0 F and 5 lb per sq in.

The compressor raises pressure from 5 to 135 lb between *D* and *E*. The vapor is then condensed back to a liquid in the condenser along the line *EFGH* and



the liquid drains back to the receiver.

The area *BCDNL* represents the heat absorbed by the ammonia in the cold room. The area *ABCDEFGA* represents the heat equivalent of work done by the compressor. The smaller this area can be made, the smaller the power bill will be.

Fig. 3 shows the effect of reducing the condensing pressure from 135 to 100 lb per sq in. Area above the line *ABCD* has now been reduced and power consumption is less. Assuming conditions as shown in Fig. 3, this would mean a saving of 33 kwhr per day for a circulation of 500 lb per hr, using a condensing pressure of 100 lb instead of 135. Therefore, MC would save about 66 cents per day if the increase in circulating water did not cost anything.

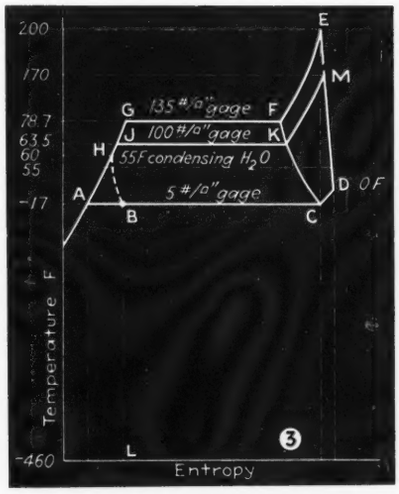
MC states that his condenser is more than large enough. A very easy test will tell. Increase the flow of water through the condenser and see if the pressure can be reduced to 90 lb. With 135-lb pressure, MC has a temperature difference between the ammonia along *FG* and the 55-F water of 23.5 deg, which is

ample. However, at 90-lb per sq in., temperature difference is only 3.5 F and it is doubtful if this condensing pressure can be reached without using an abnormally large quantity of cooling water. However, it may be possible to reduce pressure to 100 lb with a reasonably increased flow of water and save power.

Freezing time will not be affected by the condenser pressure if the compressor is in good mechanical condition. This factor is affected by the pressure in the freezing coils and the amount of ammonia circulated at that pressure. The main effect of the change in condenser pressure is to vary power consumption of the compressor. Condenser pressure is controlled by quantity and temperature of circulating water in the tubes.

After MC increases circulation of cooling water, he cannot do much else, as Mother Nature controls the water temperature in all seasons. That is the reason that refrigerating plants, using spray ponds or river water for cooling condensers, have higher condenser pressures in the summer than in the winter.

Clemson, S.C. JAMES H SAMS



Expansion Valve Clogged

IF FASTER FREEZING TIME is obtained by carrying a higher condensing pressure, it is evident that expansion valves are either partly clogged or not opened sufficiently while the plant is operated under the lower condensing pressure. Volume of liquid ammonia flowing through an expansion valve at any given setting depends upon the difference in pressure between condenser and evaporator. If equivalent results are to be expected, expansion valves must be correctly adjusted to meet pressure changes.

Assuming the ammonia system is free from impurities and foul gases, when condensing pressure is held at 135 lb g, ammonia tables show that liquid temperature will be 78.7 F with heat content of the liquid at 130.5 Btu per lb. Suppose backpressure is held at 0 lb gage with a corresponding temperature of —28 F; heat content of the liquid at that point will be 12.8 Btu with latent heat of evaporation at 589.3 Btu. Hence, 589.3 — (130.5 — 12.8) = 471.6 Btu, which is the amount of refrigeration produced per lb of ammonia fed to evaporators.

If condensing pressure is reduced to 90 lb with corresponding liquid temperature of 59.5 F, heat content of the liquid will be 107.5 Btu. Then, 589.3 — (107.5 — 12.8) = 494.6 Btu, which is the amount of refrigeration produced per lb of ammonia fed to evaporators, making a gain of 23.0 Btu, or about 5% in favor of the lower condensing pressure.

Another important and worthwhile gain from lower condensing pressure is in reduced power consumption of motors. As a general rule, there is a 1% reduction in power consumption for every 2-lb decrease in condensing pressure. As ample condenser cooling water is available at no additional cost, there is a power saving of 22%.

Fresno, Calif. E H CARLSON

Would Also Use Lower Pressure

MC DOES NOT STATE how low he has to keep temperature of the fish-storage rooms, but it is my guess condenser coils must be dirty and corroded, or else the system must be filled with foul gas, to have plenty of water at 55 F and pressure at 135 lb g. A common rule of thumb is that every 10-lb reduction in ammonia-condenser pressure represents about 5% saving in power. Using MC's conditions, this can be worked out as follows:

When liquid ammonia at 135-lb g pressure, and at the corresponding saturation temperature of 79 F, passes through an expansion valve where the pressure is 5 lb g and saturation pressure —17.2 F, each lb of liquid carries with it 130.8 Btu. Within the coil, liquid ammonia at —17.2 F and 5 lb contains 24.4 Btu recovered from the starting point, see Bureau of Standards ammonia table. Any addition of heat beyond 24.4 Btu causes some of the liquid to evaporate at that pressure.

Obviously, as soon as the high-pressure liquid passes into the low-pressure region, each lb contains 130.8 Btu, while only 24.4 Btu is needed by it in the liquid state. The remainder (130.8 — 24.4) is going to cause partial evaporation of the liquid. Extent of this evaporation may be easily found by dividing this difference by the latent heat of evaporation at the coil pressure and temperature, thus: 130.8 — 24.4 ÷ 581.6 = 0.18 or 18% of each lb of liquid that enters the coil through the expansion valve evaporates because of the excess heat contained in the liquid.

Vapor formed from the evaporation of this 18% takes useful space in the coils and has to be handled by the compressor along with the vapor that results from useful evaporation. In 24 hours, the loss will be 18 x 24 ÷ 100 = 4.32 hours in which you get practically no useful work from the system.

At a suction pressure of 5 in. Hg vacuum, heat content of the liquid is 5.9 Btu and the loss is 130.8 — 5.9 ÷ 593.7 = 21% loss of each lb. Loss in time on 24 hours run is 21 × 24 ÷ 100 = 5 hours.

With condenser pressure of 90 lb g and 5-lb suction, loss per lb is only 14% and the loss on 24 hours runs is 3.36 hours. With the same condenser pressure and 5-in. Hg vacuum suction pressure, loss is 107.5 — 5.9 = 17% and 4 hours. Thus, there is practically an hour saved out of every 24 by using 90 lb instead of 135.

Hamilton, Ont. I S ELLIOTT

Rearrange Piping

MC'S PROBLEM IS NOT UNCOMMON. Practical operating men seem to dislike a small pressure differential between head pressure and suction pressure. Under light loads and particularly in cooler weather when condenser water temperature is down, I have noticed condenser pumps throttled. The reason may be that hand expansion valves are not able to pass sufficient liquid at the lower pressure, to supply enough cooling effect. It is also possible that the piping arrangement may be such that the higher pressure is necessary to overcome pipe friction.

If MC will remember that refrigerating effect is obtained from the evaporation of liquid ammonia into a gas and that a better heat transfer is obtained from a liquid than from a gas, he may better understand his problem. To boost cooling or refrigerating capacity, the quantity of ammonia passed into the coolers must be increased. If expansion valves are too small or if the liquid or gas lines are too small, a higher head or condenser pressure will be required to force the necessary amount of liquid ammonia into the cooling coils.

While a lowering of the suction pres-

(*Continued on page* 144)

ARGUMENT CORNER

Small Industrials Need A "Doctor" Too

IN THE NOVEMBER issue of POWER, I read an item in "Speaking of Power," in which Editor Phil Swain pans hospital power plants for refusing to see a "doctor." I am in complete agreement with him as far as he goes, because most all of us have seen hospital plants that operate only by luck and a long-handled spoon. Equipment is shoddy and operation may be worse.

However, why stop at hospitals. Many small industrials are in the same boat, and the reason in most cases is the same. As long as steam and juice come through, management (which includes doctors, executives, etc) care little about what happens on the other side of the wall. I talked to one chief the other day whose overloaded plant was fairly screaming for help—his answer was that he couldn't get any money to improve his plant.

My point is this. I think POWER can do a real service for its readers by showing them how they can get across to their bosses the real importance of the power plant. I don't know whether the situation calls for a sledge hammer or a 50-page survey, but I for one would like to know how it can be done.

Buffalo, N. Y. E J KING

Watch for Waste with Steam Atomizing Burners

ON PAGE 107, October Operating Engineer, Mr J O Gibbons compares the relative merits of steam and mechanical atomizing oil burners. One of the points he brought up, that of possible unknown waste of steam with the first-named burner, was vividly illustrated in a conversation I had some time ago with a still operator at a large oil refinery.

The man seemed of average intelligence, yet after we had discussed steam vs mechanical atomizers, he still couldn't see why anyone would want to save steam. "Why," he exclaimed, "the more steam I give her, the better she burns. We have plenty of steam around here—they even have so much up at the power house, they're all the time blowing it off in the air to get rid of it."

He really meant that in all seriousness, worse luck. The point is that it is pretty tough on the boys in the power house to sweat in an effort to keep costs down and then have steam wasted out on the process end through sheer ignorance. Steam, like oil, really does cost money!

Springdale, Conn. C A SCHRADE

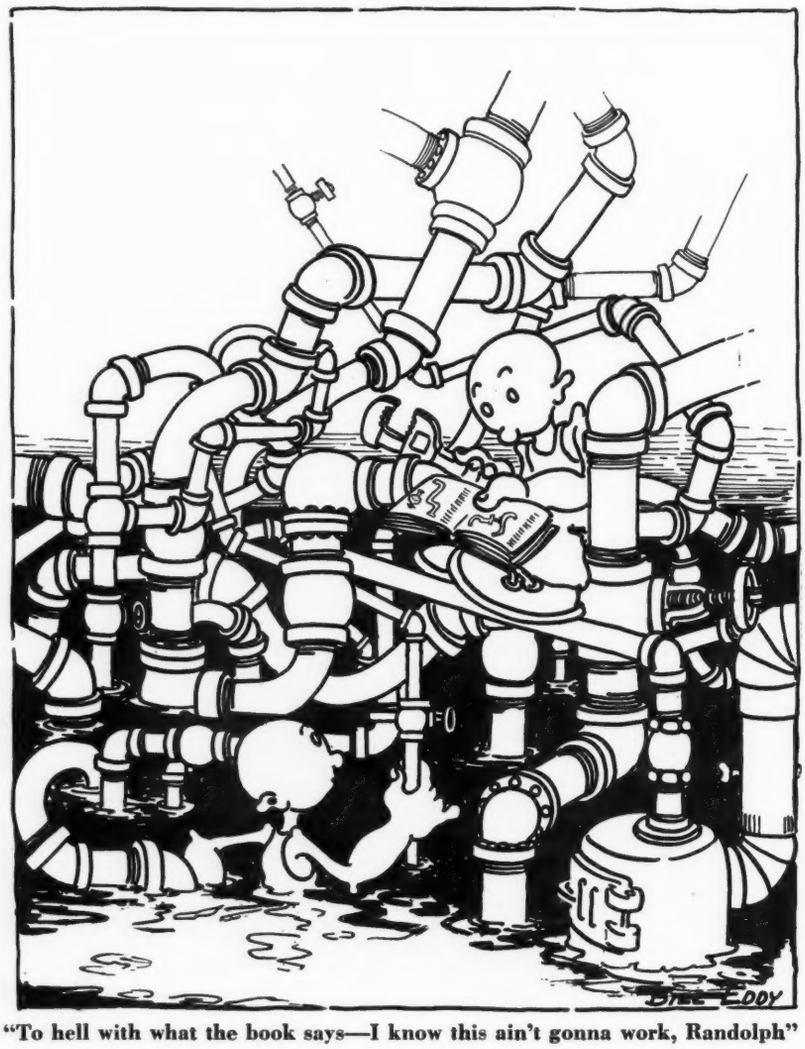
Disagrees with Method of Socketing Wire Rope

IN THE ARTICLE "How to Socket Wire Rope," shown on page 11, August Operating Engineer, I find one or two points at odds with good practice.

First, I have always found it more convenient to place the socket on the rope and slide it into the clear before removing the original end seizing. This eliminates the temporary and often troublesome end reseizing, as shown in Fig. 7 of the article, required to get the socket on after the rope end has been prepared for the spelter pour. In my method, the outward taper of the socket allows the seizing wire to be easily drawn through the smaller end, and the untwist, Fig. 6, pulled into the socket.

Secondly, I have invariably found a gasoline-soaked cloth ineffectual in cleaning the individual wires. This is especially true of used cable which may have been lubricated with almost anything, and have scum inclusions within the strands. Traces of lubricant or scum left on the wires where the untwist is limited by the seizing emulsify with the acid and spew upward with the pour, partly nullifying the pickling process. A better way to clean the rope is to slush the untwist with a cleaning solvent, then relubricate the adjacent cable after the socket has cooled.

Marissa, Ill. GEORGE BLUM



"To hell with what the book says—I know this ain't gonna work, Randolph"

SHORT QUESTIONS AND QUICK ANSWERS

More About Boilers

By Harry Spring

Q—How is the working pressure of a boiler shell determined?

A—By the formula $P = \frac{TS \times t \times \%}{R \times FS}$, where P = the maximum safe working pressure, TS = the minimum tensile strength of the shell plate, t = the minimum thickness of the shell in inches, % = the minimum efficiency of the longitudinal seam, R = the maximum inside radius, and FS = the required factor of safety—usually at least 5. The factor of safety is higher with old boilers or those in poor condition.

Q—Explain why the longitudinal seam is built stronger than the girth seam. How much stronger?

A—Because it has to withstand a greater stress due to greater projected area on which the pressure acts. The girth seam should be at least 50% of the strength of the longitudinal seam of a boiler drum.

Q—What factors are required in figuring the strength of a flat stayed surface?

A—The dimensions and type of stay, the two pitches of the stays, the thickness and material used in the plate, and a Code constant for the plate stiffness.

Q—Given a boiler 32-in. diameter, ½ in. thick, 225 lb psi maximum pressure, factor of safety of 5, steel plate of 55,000 lb psi tensile strength. Show formula for calculating and the computed efficiency required of the longitudinal seam.

A— $\frac{P \times R \times FS}{TS \times t} = \% = \frac{225 \times 16 \times 5}{55{,}000 \times .5}$ = 65.4%. One should not be misled into selecting a lap seam for this comparatively low efficiency. A butt and double strap joint is required for this pressure.

Q—How is a safety valve connected to a boiler?

A—Directly to the safety-valve nozzle with no intervening valves of any description. The connection should be of proper size to supply full safety-valve-discharge capacity.

Q—Where and how are stop valves placed on a feedwater line to a boiler?

A—In a single boiler installation, a stop valve is required between the feedwater check valve and the boiler to permit shutting off boiler pressure from the check valve for emergency repairs. In a battery of boilers, an additional stop valve is required on each individual feed line, between the check valve and the feedwater header. This is to permit shutting off of feedwater pressure from the check valve for emergency repairs.

Q—What is the minimum and maximum size blowdown?

A—1-in. minimum; 2½-in. maximum.

Q—What is the minimum size feedwater pipe permitted?

A—¾-in., except for boilers having not over 100 sq ft of heating surface, where it may be ½-in.

Q—When is a manhole not required in a boiler?

A—In hrt boilers not over 40-in. diameter, in internally fired boilers not over 48-in. diameter, in most vertical firetube boilers, and in a few other types where entrance to the boiler would not be possible.

Q—What would you do if a lap crack were discovered in the longitudinal seam of a boiler?

A—Take the boiler out of service at once. If the boiler is not over 15 years old, Pennsylvania permits a new course of plate. No other repairs allowed.

Q—What would be done with a plate in which the edges of a handhole were corroded badly?

A—The edges should be cut back to solid metal and an elliptical ring placed inside, seal welded around the edges.

Q—If the crown sheet of a locomotive-type boiler has bagged badly, and pulled free from the stays, what should be done?

A—Put in a new crown sheet.

Q—What are firecracks, and may they be repaired? How?

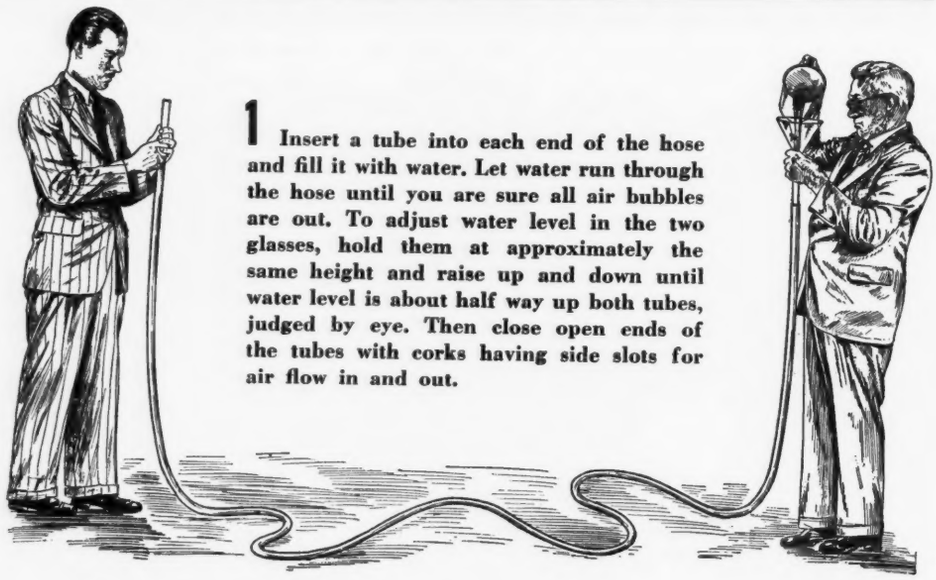
A—They are cracks in plate, usually at a riveted seam, extending from rivet hole to caulking edge. They are caused by excessive expansion of the surface of the lapped plate exposed to radiant heat of the fire. The differential in expansion between the two surfaces of the plate causes cracking. If the crack does not extend more than several inches into the solid plate, and if leakage develops, repairs may be made by removing adjacent rivets, veeing the cracks and electric welding them. The rivet holes should be reamed and new rivets driven.

Q—Can a tube ligament crack be repaired? How?

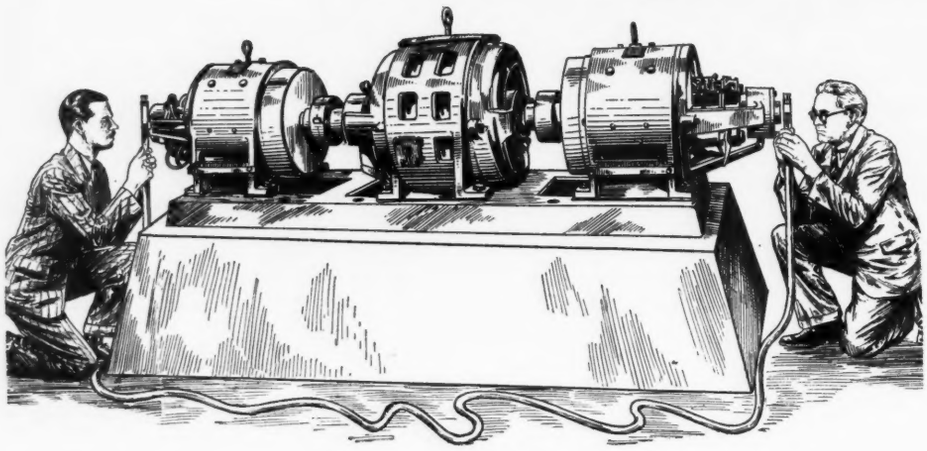
A—If in a flat tube sheet, the adjacent tubes may be removed, the crack veed and electric welded, the tube holes reamed, and new tubes installed. If in the ligament of a drum, no repairs should be attempted.

HOW TO MAKE AND USE A WATER LEVEL

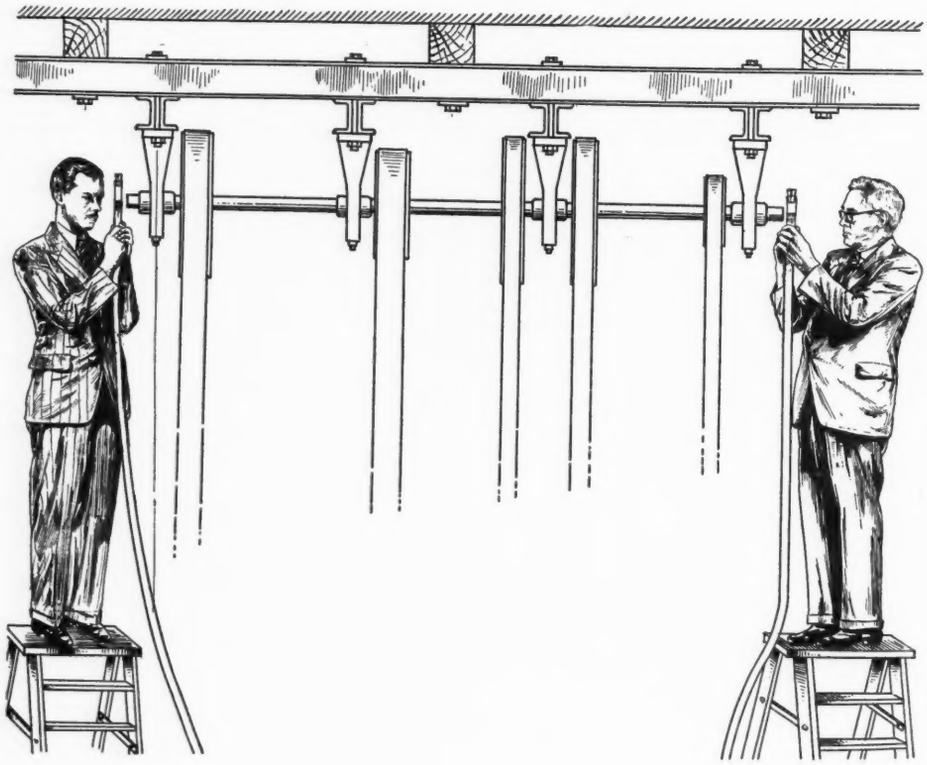
ENGINEERS KNOW that water finds its own level, but comparatively few take advantage of this well-known principle when they want a level. The drawings on this page show how to make a simple device from a length of hose or rubber tubing and two glass tubes. Garden hose and water-column gage glasses will do the trick nicely.



1 Insert a tube into each end of the hose and fill it with water. Let water run through the hose until you are sure all air bubbles are out. To adjust water level in the two glasses, hold them at approximately the same height and raise up and down until water level is about half way up both tubes, judged by eye. Then close open ends of the tubes with corks having side slots for air flow in and out.



2 Here the level is put to use checking level of a long motor-generator shaft. Hold tubes near ends of shaft. Move one tube up or down until water level in the other lines up with the shaft center. If shaft is level, water surfaces in the tubes will be at shaft center at both ends. Water level above or below shaft center at one end shows amount out of level.



3 Checking a line shaft. Procedure is the same as in Fig. 2 (level to top of shaft instead of center if more convenient). Other applications for this device are projecting a level from a mark on one wall to another, leveling beams and foundations, and determining the slope of drains and pipes.

Suggested by E J Duff, Aurora, Colo.

ARM'S LENGTH OR A HUNDRED FEET AWAY

IT'S THE PYREX BROAD RED LINE GAUGE GLASS THAT STANDS OUT

At any distance—whether illuminated by ordinary reflected light or by rear illumination—the fused-in, transparent, broad red line of this gauge glass gives greater visibility of water level from any angle.

That's a *plus* factor added to a gauge glass already noted for its greater mechanical strength, resistance to sudden temperature changes, permanent transparency and machine drawn accuracy.

"Pyrex" Broad Red Line Gauge Glasses, in all standard sizes and in *odd-lengths*, are readily obtainable at leading mill and steam supply dealers.

"PYREX" is a registered trade-mark and indicates manufacture by Corning Glass Works

Pyrex GAUGE GLASSES

BRAND

CORNING GLASS WORKS, CORNING, N.Y.

Every Plant Must Answer This One

EARLY IN 1940 every industrial power plant in the United States will have a little job to do for the U. S. Government. The Bureau of Census, Department of Commerce, has completed its plans to survey all manufacturing establishments whose value of product exceeds $5,000 during the year 1939.

On Jan 2, 1940, an army of 12,000 enumerators, armed with schedule forms and legal power to demand the answers, will start visiting approximately 200,000 establishments in 400 industries. This field work will take four to five months.

During 1940 the Bureau expects to publish the basic results, tabulated by state and by industry—later by industrial areas, counties, cities and towns.

While the Census of Manufactures is taken every two years, this will be the first since 1929 to include extensive data on power and fuels. Inquiries 6 and 7 (power equipment, fuel and energy) will appear on all schedules exactly as shown herewith. In addition, Inquiry 5 (not shown) calls for: (b) Cost of fuel actually used during the year (total dollars); (c) cost of purchased electricity used for all purposes during the year (total dollars).

The Census Bureau has prepared one general schedule, 147 special schedules for certain industries, and one administrative-office schedule. The list of special schedules may be obtained from the Bureau on request.

For an important suggestion re this census, see editorial on page 55.

INQUIRY 6.—POWER EQUIPMENT—The figures given in this inquiry should relate to equipment in use or available for use at the end of the period covered by the report.

TYPE	PRIME-MOVERS DRIVING GENERATORS (Direct-connected and connected by gears or by belts)						PRIME MOVERS NOT DRIVING GENERATORS			
	Number	Key	Prime movers: Total rated horsepower	Key	Generators: Total kilowatt rating	Key	Number	Key	Total rated horsepower	Key
(a) All equipment, available for use, active and idle:										
Steam engines		F-1		F-2		F-3		G-1		G-2
Steam turbines		F-4		F-5		F-6		G-3		G-4
Diesel and semi-Diesel engines		F-7		F-8		F-9		G-5		G-6
Other internal-combustion engines (gas, gasoline, etc.)		F-10		F-11		F-12		G-7		G-8
Hydro-turbines and water wheels		F-13		F-14		F-15		G-9		G-10
(b) Equipment, included above, ordinarily idle but held for standby (not junk)	x x x x	x x x		F-16		F-17	x x x x	x x x		G-11

	Key
	G-12

ELECTRIC MOTORS

	Number	Key	Total rated horsepower	Key
(a) Electric motors driven by purchased energy		G-13		G-14
(b) Electric motors driven by energy generated in the plant		G-15		G-16

INQUIRY 7.—FUEL AND ELECTRIC ENERGY USED (Do not include coke or gas manufactured in the plant from other fuels):

	Code	Key	Unit	Quantity	Key	Cost delivered at factory		
Coal, bituminous (soft, including lignite)			Short ton		H-1	$		
Coal, anthracite (hard)			Short ton		H-2	$		
Coke			Short ton		H-3	$		
Fuel oil (including heating oils but not gasoline or lubricants)			Bbl. (42 gal.)		H-4	$		
Gas, natural	1	H-5	M. cu. ft.		H-6	$		
Gas, manufactured	2		M. cu. ft.			$		
Gas, mixed	3		M. cu. ft.			$		
Total amount of electric energy generated in your plant			Kw.-hr.		H-7	x x x x x x x		
Total amount of electric energy sold			Kw.-hr.		H-8	x x x x x x x		
Electric energy purchased (report the same cost as reported under Inquiry 5 (c))			Kw.-hr.		H-9			H-10

TEXROPE DRIVE "GOING STRONG!"

AFTER 10 YEARS ON THE JOB!

Another true case history from the Allis-Chalmers files that proves **"IT PAYS TO BUY THE EQUIPMENT THAT PAYS FOR ITSELF!"**

250-HP Texrope Drive Turns 60-Ton Tube Mill in Large Midwestern Quarry . . . Goes Ten Years Without Maintenance Costs! Find Out How YOU Can Cut Transmission Costs with Texrope Drives!

TEN YEARS ON THE JOB AND STILL good for a long time — that's the history of this 250-hp Texrope Drive. C. G. Wolf, assistant superintendent at Waukesha Lime & Stone Co., Waukesha, Wisconsin, examines the drive and reports — "Still going strong!"

Crushing rock is no easy job! Because it's a low-priced commodity, rock pulverization has to be done at lowest possible cost . . . with equipment (especially transmission equipment) that has wide safety margins and extremely low maintenance!

At the Waukesha Lime & Stone Company, they have a 250-hp Texrope Drive on a 60-ton tube mill that has been giving rock-bottom transmission costs for over ten years!

Profit with Texrope!

Now, after ten years, here's its story: — the same original seventeen belts on this Texrope Drive are still in use . . . still handling the torque strain of turning 60 tons from a dead stop. Not one cent has been spent on this mill for transmission maintenance in all that time. And C. G. Wolf, assistant superintendent, states his Texrope Drive is "still going strong!"

Whatever your problem, these are interesting facts . . . especially if you are looking for a money-saving solution to a tough transmission job.

It will pay you to get the full Texrope Drive story—about the new, special, cool-running rubber compound that means even longer belt life than before . . . the scientific matching of belts into "sets" for equal pulling and wear . . . the "wedge" construction for highest operating efficiencies (up to 98.9%).

For all industrial transmission needs between ¼ hp and 2,000 hp, call the Allis-Chalmers district office or representative near you. Or write to Allis-Chalmers, Milwaukee, Wisconsin.

A-1160

Vari-Pitch Speed Changers • Texrope V-Belts • Duro-Brace Texsteel Sheaves • Vari-Pitch Sheaves • Standard Cast Iron Sheaves • Adjustable Pitch Diameter Texsteel Sheaves • 2-3-4 Combination Sheaves • Straitline Automatic Motor Bases • Oil Field Drilling Rigs

Belts by Goodrich

TEXROPE DIVISION

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

Engineers' Bookshelf

Air Conditioning

HEATING AND AIR CONDITIONING (5th Edition, 1939). *By the late John R Allen and James H Walker, Supt of Central Heating, The Detroit Edison Co. Published by McGraw-Hill Book Co, 330 West 42nd St, New York, N. Y. 593 pages, 6x9 in., 301 illustrations, 97 tables, an appendix of 13 tables, cloth binding. Price $4.50.*

This 5th edition of what has become a standard text in the heating and air-conditioning field brings the book abreast of developments in the art. Major changes are found in the chapters dealing with air conditioning, as most rapid changes have taken place in this field. In line with this, the chapter on warm-air heating has been split into chapters on gravity systems and on forced-warm-air systems, the basis of residential air conditioning. Material has been added on controls, air distribution, cooling-coil performance, and cooling-load calculations. A completely new feature is a chapter devoted to step-by-step calculations for the design of an air-conditioning system.

New England Manufacturers

DIRECTORY OF NEW ENGLAND MANUFACTURERS (1939). *Published by George D Hall Inc, 665 Boylston St, Boston, Mass. 700 pages, 8x11 in., cloth bound. Price $20.00.*

New revised edition of this guide to New England's industrial activity contains four sections: Alphabetical, geographical, product and trade-name. The first lists about 17,000 New England manufacturers, with names of chief executives, name of product made, number of employees, capitalization, location of plants and branch offices.

Geographical section lists the same companies by state, city or town. Third section lists thousands of different products classified under main and sub-heads and arranged alphabetically for easy reference. Finally, all brand names and trade marks are listed alphabetically, to enable anyone who knows only the name of a product to identify the maker.

Heating-System Fittings

STEAM AND HOT-WATER FITTINGS (1940). *By William T Walters, Heating and Ventilating Engineer, Illinois Engineering Co. Published by American Technical Society, Drexel Ave & 58th St, Chicago, Ill. Cloth binding, 184 pages, 5½x8½ in., 182 illustrations, 31 tables. Price, $2.00.*

Here is a practical book that anyone interested in steam and hot-water heating systems can read with profit. It is intended for students, apprentices, steamfitters, draftsmen, and designers and tells how to design the system according to good practice and how to select equipment best suited to the job and install it so that it will operate satisfactorily.

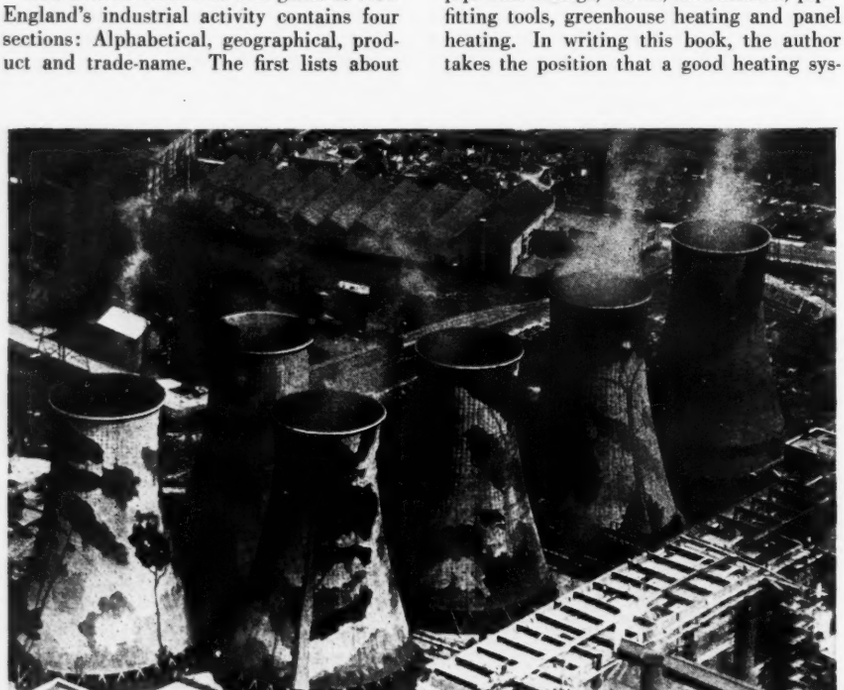
The subject matter includes boilers of various types and methods of firing, steam radiators and coils, steam and hot-water heating systems of different types, pumps, pipe and fittings, valves, unit heaters, pipe-fitting tools, greenhouse heating and panel heating. In writing this book, the author takes the position that a good heating system is the heart of any building and proceeds to show how to design carefully, purchase correctly and install properly.

Romance of Atoms

ATOMS IN ACTION; THE WORLD OF CREATIVE PHYSICS (1939). *By George Russell Harrison, Director of the Research Laboratory of Experimental Physics at Massachusetts Institute of Technology. Published by William Morrow & Co, 386 4th Ave, New York, N. Y. Cloth binding, 6x8½ in., illustrated. Price, $3.50.*

The World in Which We Live would probably better describe this book than Atoms in Action. The author omits a preface, so we do not know what his purpose was in writing the book, but it certainly takes the reader on a most fascinating journey through the highways and byways of physics that have lead to the world in which we live today.

Even those of us who are technically trained have a feeling that the research physicist and chemist have reached so far out into the outer realms of knowledge that not one but one of their kind can understand them. Maybe this is true of relativity, the fourth dimension and other abstruse subjects. But here is a story connected with the works of the research physicist and how these are being applied to industrial processes and to an improved social order, that is more fascinating than the best fiction. This is the story that Professor Harrison tells in his book in a way that even a school boy can understand, but with an authority and clarity that marks the author as a master of prose as well as physics. For those who would better understand the world in which we live, this book is heartily recommended.



British Combine Photo

CAMOUFLAGE

War brings art new business as power plants in England mask their identities. Here, cooling towers at the Leicester Electricity Works are made to blend with the landscape—at 5000 ft, they are said to be unnoticeable

Autobiography

MY 50 YEARS IN ENGINEERING (1939). *By Embury A Hitchcock, in collaboration with Merrill Weed. Published by The Caxton Printers, Ltd, Caldwell, Idaho. 277 pages, 6x9 in., 36 illustrations, cloth binding. Price $3.00.*

The subtitle of this book sums up its contents admirably—"The Autobiography of a Human Engineer". From his student days at Cornell University, through early employment with Corliss, teaching at Ohio State, power-plant testing for many Midwest utilities, years with an engineering firm specializing in hydroelectric and steam power, to his final post as Dean at Ohio State, Embury Hitchcock was filled with a real love of engineering. And through his fifty years of practice, which spanned the greatest period of growth in the mechanical field, he never lost his interest in human beings—in his students, his faculty colleagues, and his engineering associates.

This interest shines through the simply told story, whether the author is telling of engineering adventures in Mexico, of a trip

Choosing Materials for Edward Valves — *No. 11 of a Series*

FINE SCIENTIFIC EQUIPMENT AIDS EDWARD MATERIAL CHOICE

HEAT, not high pressure, supplies the theme for research to govern the choice of valve materials. Corrosion, dread cause of excessive costs and occasional disasters, often surrenders without a struggle if the true nature of the destructive forces can be correlated with newly developed materials. High temperatures, however, still offer wide scope for study. Plastic flow of alloys in almost immeasurably small increments, invisible grain transformation at indeterminate rates, effect of long continued temperature fluctuating at irregular intervals — these suggest roughly the elements with which the valve metallurgist wrestles. Outstandingly fine equipment helps Edward technicians find why materials make valves behave the way they do.

• • •

THE EDWARD VALVE & MFG. CO., INC.
EAST CHICAGO INDIANA

EDWARD VALVES

Stop · Check · Blow-off · Non-return · Feed Line · Relief · Bleeder Line · etc.

to the World Power Conference, or of two of his most famous students, Charles F Kettering and E G Bailey.

Old-timers in the power field will enjoy Dean Hitchcock's reminiscences of early days and many embryo engineers will benefit by seeing through his eyes the dramatic development of engineering in one lifetime, and by learning what engineering meant to one man.

Lubrication

LUBRICANTS AND LUBRICATION (1939). *By James I Clower, Associate Professor of Machine Design, Virginia Polytechnic Institute, and formerly Technical Editor, Vacuum Oil Co. Published by McGraw-Hill Publishing Co, 330 W 42nd St, New York, N. Y. Cloth binding, 464 pages, 6x9 in., 338 illustrations, 48 tables. Price $5.00.*

Man's fight against friction extends back almost to his earliest existence, but only during comparatively recent time has the problem been attacked scientifically and practically. Today many of our modern machines would not be possible were it not for modern bearing designs and high-grade lubricants.

Much has been written on lubrication that is beyond the grasp of the practical operating engineer. This book, however, is essentially practical and combines the experience of the operating engineer with that of the teacher. To give a background on which to build a knowledge of good lubricating practice, the first two chapters are devoted to crude petroleum and its refining.

These are followed by chapters on petroleum products, fixed oils and fats, solid lubricants and greases, lubricating-oil tests and fundamentals of lubrication. The rest of the book deals with the practical application of lubricants under these chapter headings: lubricating appliances and systems; oil purification methods; lubrication of ball and roller bearings, steam turbines, steam engines, air compressors, refrigerating machines, internal combustion engines; and storing and handling of lubricants.

The two chapters on lubricating appliances and systems and oil-purification methods, cover practically every known device for applying oil or grease to bearings and the different methods for cleaning oil in power and industrial plants.

Hydraulics

MANNING FORMULA TABLES FOR SOLVING HYDRAULIC PROBLEMS (1939). *By Horace W King, Professor of Hydraulic Engineering, University of Michigan. Published by McGraw-Hill Book Co, 330 W 42nd St, New York, N. Y. Fabroid cover; 379 pages, 6x9 in. Price $5.00.*

In 1937 the author published his Manning Formula Table for the Solution of Pipe Problems, for flows of 0.001 to 10,000 cu ft per sec and for pipelines with diameters up to 200 in. The new volume contains a main table covering 352 pages and 6 auxiliary tables that simplify the application of the Manning Formula to flow in open channels, as his previous work does on pipelines.

These tables provide a direct solution of problems involving open-channel flow commonly encountered in engineering practice and reduce the labor of computations to a minimum, no calculations other than simple multiplication and division being required. They include discharge values of from less than 1 to over 100,000 cu ft per second.

Electricity

INDUSTRIAL ELECTRICITY (Part 1, 1939, 2nd Edition). *By Chester L Dawes, Associate Professor of Electrical Engineering, Graduate School of Engineering, Harvard University. Published by McGraw-Hill Book Co, Inc, 330 W 42nd St, New York, N. Y. Cloth binding, 287 pages, 5½x8 in.; 269 illustrations. Price $2.20.*

Here in simple language is explained the principles underlying electrical engineering and electrical equipment in a way that gives a bird's-eye view of these problems to students seeking a practical knowledge of principles. The book is written primarily as a text for technical high schools and similar institutions, but is well suited for home study, as the treatment is practical and easily understood.

This volume is devoted to fundamentals of electricity and magnetism and to direct-current machines. The 13 chapter subject heads are: resistance, Ohm's law and the electric circuit, battery electromotive force —Kirchgoff's law, primary and secondary batteries, storage batteries, Edison nickel-iron alkaline cell, electrical instruments and measurements, measurement of resistance, cable testing, measurement of power and energy, magnetism and permanent magnets, electromagnetism, the magnetic circuit, inductance, electrostatics—capacitance, the dc generator, dynamo construction, generator characteristics, shunt generator, the dc motor, losses—efficiency-operation, and automobile starting and lighting systems.

Changes have been made in the new edition to bring it up-to-date and to make it conform to modern practice. The arrangement of the material has also been changed to make it conform with the suggestions of teachers and students.

Public Speaking

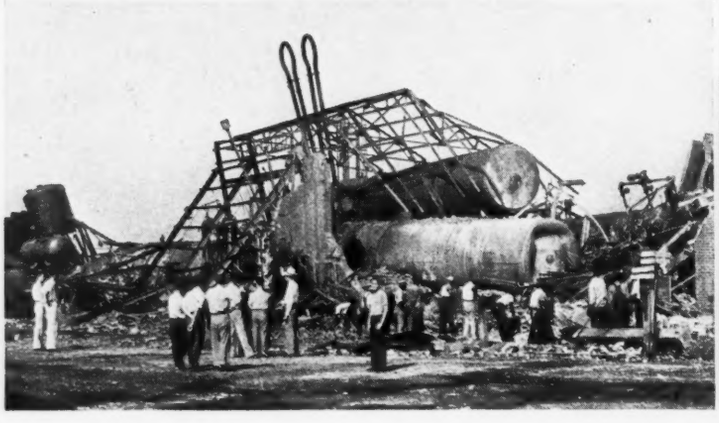
PUBLIC SPEAKING FOR TECHNICAL MEN (1939). *By S Marion Tucker, The Polytechnic Institute of Brooklyn. Published by McGraw-Hill Book Co, 330 West 42nd St, New York, N. Y. 400 pages, 5½x8¼ in., cloth bound. Price $3.00.*

No one questions the statement that it would be profitable and pleasant if all of us could speak before an audience without putting it to sleep. Many first-class engineering meetings have curdled because speakers, who really had good information and were A-1 engineers, fumbled the spoken word badly.

Thus, it should make all of us happy to have a book for our very own, a book to tell us what's wrong with our speech-making and how to make ourselves at least intelligible. Mr Tucker's book has been aimed at just that purpose, but in our opinion falls short because of its "sales" slant. Since Mr Dale Carnegie's book, "How to Win Friends and Influence Peo-

IRON HORSE TO THE RESCUE

When an explosion destroyed the plant of the Century Wood-Preserving Co, Charleston, S. C. (below), one man was killed and $200,000 damage resulted. Engineers carried on by running a locomotive in on the plant siding to supply enough steam for 40% of normal output



Savings!

TREATMENT COSTS NOW $500.00 A YEAR LOWER

ABILITY of Nalco to increase the efficiency of existing softening plants has been demonstrated time after time. One of the most recent reports coming in from the field credits Nalco with a saving totalling $500.00 a year.

WATER BILLS CUT $150.00 PER MONTH

BECAUSE Nalco treatment has enabled them to operate successfully with water from their own well for boiler make-up, one company reports a saving of $150.00 a month on water bills. This is typical of Nalco's ability to get good results with any water.

SAVES $5,000.00 ON BOILER MAINTENANCE

SOME PLANTS keep complete records on all items that go to make up operating costs. It was in one such plant that Nalco was credited with a saving in boiler plant maintenance costs of $5,000.00 in the first year.

INCREASE IN EQUIPMENT CAPACITY WORTH $1,250.00

LAST YEAR the engineer in a prominent plant was just about ready to spend $1,250.00 for increased facilities for reducing the temperature of cooling water. Then he heard about Nalco Stabilizing Treatment. With scale prevented by Nalco, heat transfer jumped up and there was no need for more equipment.

YOU have heard about the ability of Nalco to stop trouble and improve performance, but cutting costs is one of the major aims of Nalco engineers. That's why you can hardly afford to not know what Nalco offers. We will be glad to tell you without obligating you in any way. Call or write.

NATIONAL ALUMINATE CORPORATION
6222 W. 66th Place **Chicago, Ill.**

Inquiries other than domestic, except those from U. S. Possessions, Canada and Mexico should be addressed to ALFLOC LTD., Bush House, Aldwych, London, W. C. 2, Eng. Canadian inquiries should be sent to ALUMINATE CHEMICALS LTD., 372 Bay St., Toronto, Ont.

THE NALCO SYSTEM OF FEEDWATER TREATMENT

PEAK POWER

The first of what is expected to be a fleet of diesel-powered passenger trains nears the summit of Pike's Peak, 14,109 ft above sea level. With three 160-hp General Motors 2-cycle diesels furnishing the motive power, the locomotive pushes the 52-passenger observation car up the steep slope in little more than an hour

ple", which had a lot of us running about with fierce desire written on our faces—fierce desire to impress our fellow men—we have often thought how nice it used to be when we could meet people and not have to be their friend on the spot.

Nevertheless, with these faults, the book has a lot of good information in it. After we had gotten over our irritation at being "sold", we were able to find out why so many people assumed glazed looks when we spoke. We learned how to organize a speech, to keep contact with an audience, and which platform mannerisms help hold our listeners.

The Palomar Telescope

THE GLASS GIANT OF PALOMAR (1939). *By David O Woodbury. Published by Dodd, Mead & Co, New York, N. Y. Cloth bound, 6½x9½ in., 368 pages. With 50 drawings by the author and sketches by Russell W Porter. Price $3.00.*

We are moved to make this review a personal note. Only a few years ago Dave Woodbury was one of the "POWER gang"—edited our news section efficiently and didn't make much noise about it. Now he's written a big book on the 200-in. telescope and naturally we want to review it for old time's sake, even though its subject may seem a little bit outside POWER's normal field.

So we sat down and read it—every word of the 368 pages—and can report our findings in a line: "You're a better man than we are Dave, a whole lot better."

This book is really a magnificent piece of work. Some of us have been going around the world with a lantern, like Diogenes, trying to find an engineer of understanding and first-rate literary skill, a man who could write of machines as Conrad wrote of ships, or Van Loon of the arts. We've found the man and his name is Woodbury.

But don't get the idea that "The Glass Giant of Palomar" is just a piece of mighty smart writing about the world's smartest telescope and telescope makers. Some writers are too darn clever with words for what they can offer of understanding of their subject. Not so Dave. He dishes out none of the customary lilac-scented popular-science soup. He knows his astronomy. He knows telescopes—built his own to make sure. Above all, he knows the gigantic Palomar instrument, the men who made it and the men who made it possible.

No reader can fail to see that Woodbury has lived and dreamed his subject. The book itself reminds me of that 200-in. mirror, cast from the best material, rough ground with long labor, polished and figured with infinite pains to a true parabolic surface, then precisely mounted and directed to gather the desired light and bring it to the right point.

It should be noted, in conclusion, that this Palomar project, in all its parts, is probably today's most important example of a specific achievement by the teamwork of "pure science" and engineering.—*PWS*

Heat Power

HEAT POWER (2nd Edition, 1939). *By Earle B Norris, Virginia Polytechnic Inst. and Eric Therkelsen, Montana State College. Published by McGraw-Hill Book Co, 330 West 42nd Street, New York, N. Y. 432 pages, 6 x 9 in., 266 charts and diagrams, tables, problems and answers, and a combustion chart, cloth binding. Price $4.00.*

This second edition of a textbook intended primarily for students in engineering, includes a simplified discussion of boiler types, and has been brought up to date for new illustrations of modern equipment, by use of latest data on specific heats of gases and on properties of steam, and by use of generally accepted abbreviations and symbols.

This edition follows the plan successfully set in the earlier work; that is, it introduces the subject of internal-combustion power plants first, using the familiarity with the gasoline engine as a stepping stone to the more complex and less well-known features of steam power plants.

Vapor Charts

VAPOR CHARTS AND SPECIAL TABLES FOR TURBINE CALCULATIONS (1939). *By F O Ellenwood and C O Mackey, Professors of Heat-Power Engineering, Cornell University. Published by John Wiley & Sons, Inc, 440 Fourth Ave, New York, N. Y. 17 plates, 6 tables, 8½ x 11 in. Price $2.50.*

Latest steam tables in chart form are divided into parts of convenient size for easy reading. Enthalpy (heat content) is plotted against a logarithmic scale of specific volume. Pressures range from 5500 lb to 0.18-in. Hg, temperatures from 1200 to 32 F.

In these new charts, properties of water at high temperatures and pressures have been plotted on separate charts to aid in high-pressure boiler-feed-pump calculations. Other plates and tables give properties of ammonia, freon and mixtures of air and water vapor as well as corrections for barometric readings, steam-jet velocities, etc.

Smoke Prevention

MANUAL OF ORDINANCES AND REQUIREMENTS (1939). *Published by the Smoke Prevention Association, 139 N Clark St., Chicago, Ill. 172 pages, 6 x 9 in., paper cover. Price 50 cents.*

In addition to the complete text of papers presented at the 33rd Annual Convention of the Smoke Prevention Association, this pamphlet contains latest information on smoke ordinances in principal cities, model smoke laws, practical elementary lessons in burning fuels without smoke, methods of testing for solids emission from flue gas.

Diesel Costs

OIL-ENGINE POWER COST REPORT FOR 1938. *Published by ASME, 29 W 39th St, New York, N. Y. Cost to members, 80 cents; to non-members, $1.00.*

This report, prepared by a subcommittee of the Oil and Gas Power Div, ASME, records actual operating costs of diesel generating plants. Plants are classified as building, industrial, municipal, private power-company, and municipal pumping. In addition, plants are also keyed to indicate whether they are at base-load, complete-power, peak-load, or standby.

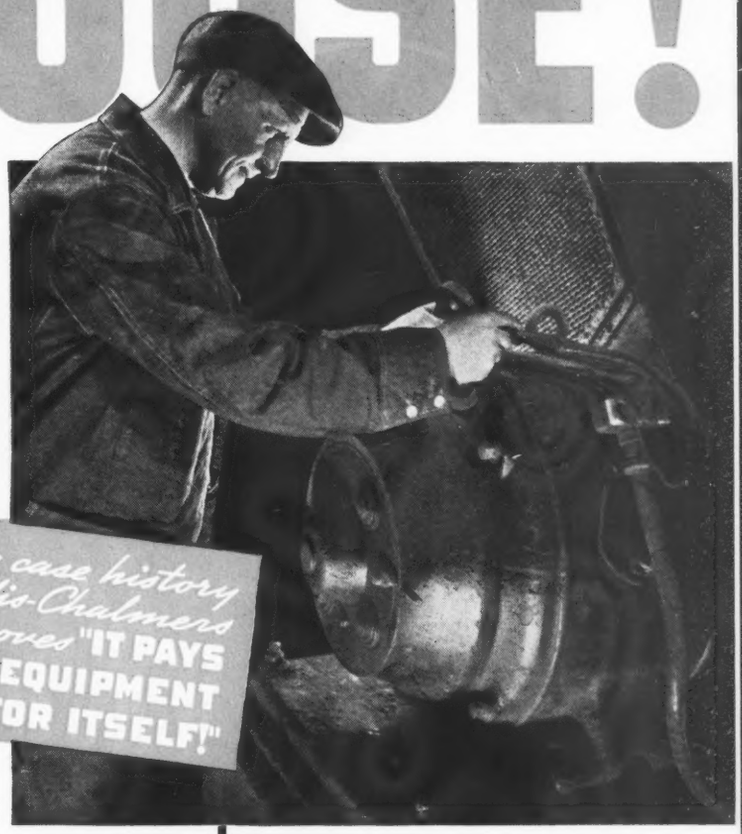
As in past reports, no data on investment costs or fixed charges are included. Production costs are given in detail and cover data from 151 oil-engine generating plants containing 444 engines, totaling 248,548 rated hp. The total net output for the plants tabulated in the 1938 report amounted to 318,636,891 kwhr.

Information on production costs for each of the 151 plants is presented in Table I and includes capacity load and net output data in addition to the unit costs making up total production cost. Table II shows the comparative production costs for each of two or more years for 132 plants. Each succeeding year has added to the value of

(*Continued on page* 132)

36 YEARS IN THE GAS HOUSE!

Dramatic 36 Year Performance Record of 25 Allis-Chalmers Motors Told by R. B. Brown, President, Milwaukee Gas Light Company! Find Out How Lo-Maintenance Motors with Full Measure Construction Can Save Money For You!



FIGHTING SOME OF THE WORST POSSIBLE CONDITIONS any motors could meet — that's what 25 Allis-Chalmers Lo-Maintenance Motors, like the one pictured above, had to do for 36 years without running up costly repair bills!

Fighting steam and hot coke . . . rain and snow . . . surrounded by some of the worst operating conditions any motor could face — that's what 25 Allis-Chalmers Lo-Maintenance Motors had to meet and beat . . . for 36 years . . . and do it with a minimum of maintenance!

And when R. B. Brown, president, Milwaukee Gas Light Co., tells a sensational performance story like that . . . we give it to you — in his own words—just as he gave it to us in his unsolicited letter of Nov. 29, 1938.

Chooses Allis-Chalmers!

"When our West Side Works was built in 1902," said Mr. Brown "it was the first gas works to be entirely equipped with motors. And those motors were Allis-Chalmers. Steam and hot gases from quenched coke surrounded the motors. Some were installed in wet coal breaker pits . . . in outdoor locations swept by rain and snow. You couldn't have hand-picked a set of worse conditions in which to test motors!

"Last year we shut down this plant. And here's what we found! Those 25 Allis-Chalmers Motors were still going strong! And to top it off, we have had hardly any maintenance expense . . . and not one motor had to be replaced!

"Now I don't know of any other motors that have had such life. And when you add that this plant has operated 24 hours a day, 365 days a year for 36 years—that in itself adds very materially to the job these Allis-Chalmers motors have done!"

It's records like these that prove you get more than just a rated horsepower when you install Allis-Chalmers Lo-Maintenance Motors. And it's records like these that are making men, responsible for production in their plants, switch to Allis-Chalmers!

They know about the high carbon steel frame, indestructible rotor and distortionless stator . . . husky Full-Measure construction with no skimping on materials—that's a combination that knocks their repair bills to a real low!

Get the whole story of how Allis-Chalmers 90 years of advancing with industry works for you when you install a Lo-Maintenance Motor. Call the nearest district office or write direct to Allis-Chalmers. That's the way to get started on cutting your maintenance costs . . . keeping your production steady!

MOTORS FOR ALL APPLICATIONS FROM ½ HORSEPOWER AND UP

ELECTRICAL DIVISION

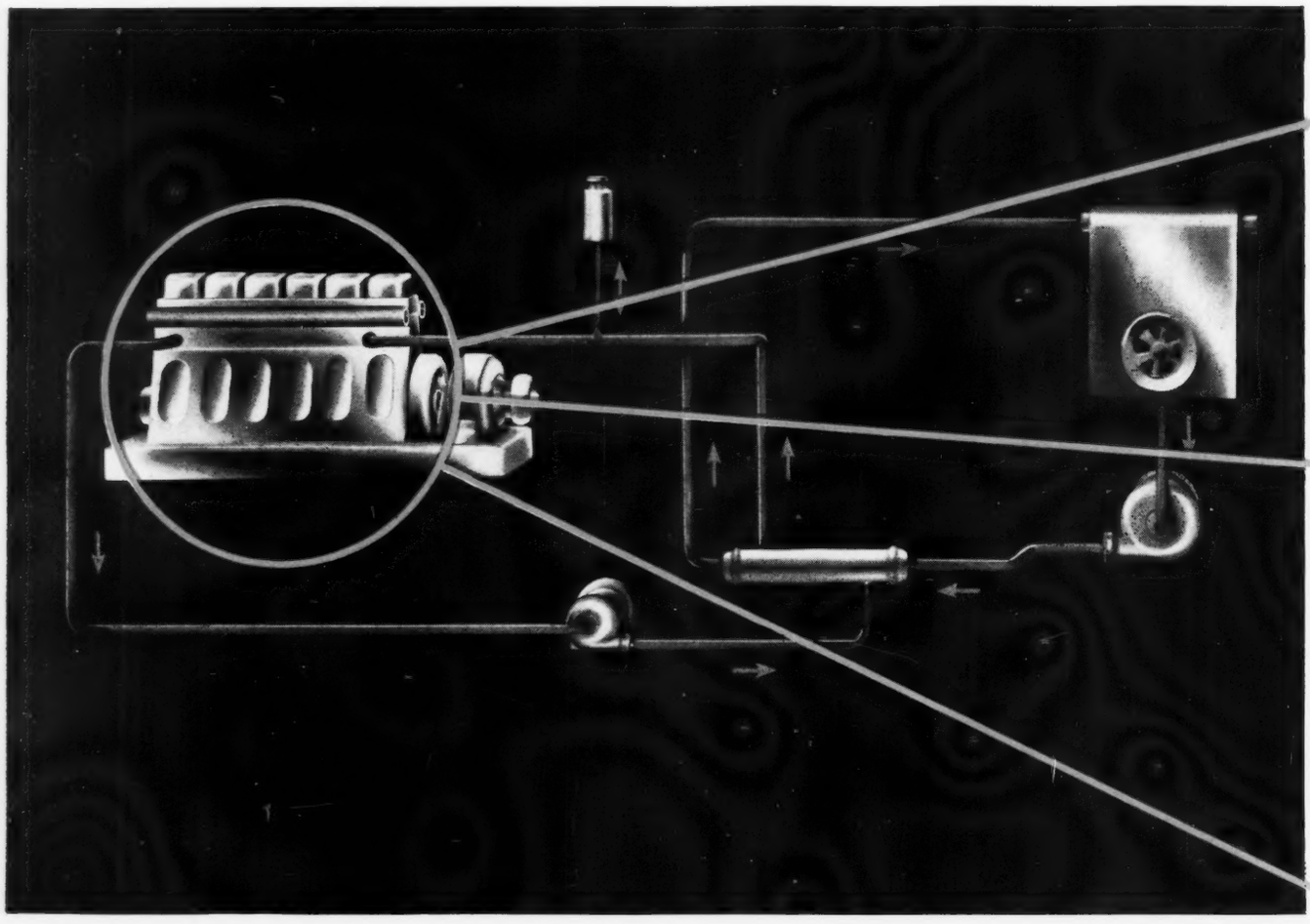
ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

1070

FROM *GOOD* POWER HOOKUPS

FOR DIESEL SERVICES...



Courtesy—Power, Dec. 1938

HOOKUP #12 **Double-circuit cooling circulates pure water in the closed circuit. Heat is rejected to raw water in a heat exchanger, tubes of which can be easily cleaned if scale forms. Evaporative condensers and some cooling towers give double-circuit effect without separate heat exchanger. Surge tank provides for expansion of water in closed circuit.**

WHEREVER you go in the power plant, it is more than likely that guidance to valve specification and replacement can be found in this Jenkins "Good Valve Practice" advertising.

For twelve months now we have reviewed the important applications of valves—and recommended Jenkins Valves for each application. Incidental to this, we have also revealed the wide variety of Jenkins Valves available for any specific service.

In carrying out such a program, it became obvious that engineers would find this series of advertisements especially helpful in complete booklet form.

We would be glad to receive a reservation now for your copy—which will be forwarded as soon as this booklet is off the press.

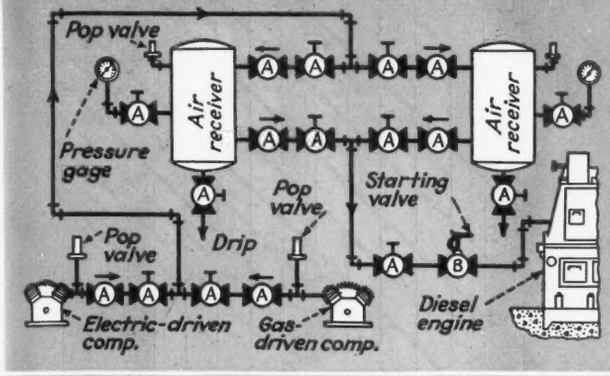
NEXT ISSUE — DIESEL APPLICATION

IN VALVES *Jenkins* GIVES YOU EVERYTHING

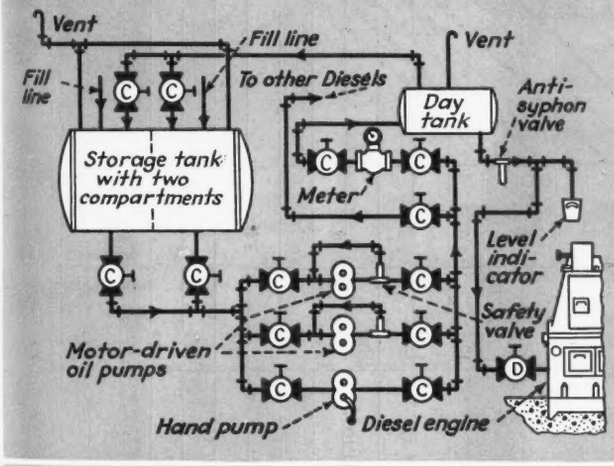
. . . TO *GOOD* VALVE PRACTICE

Jenkins RECOMMENDS . . .

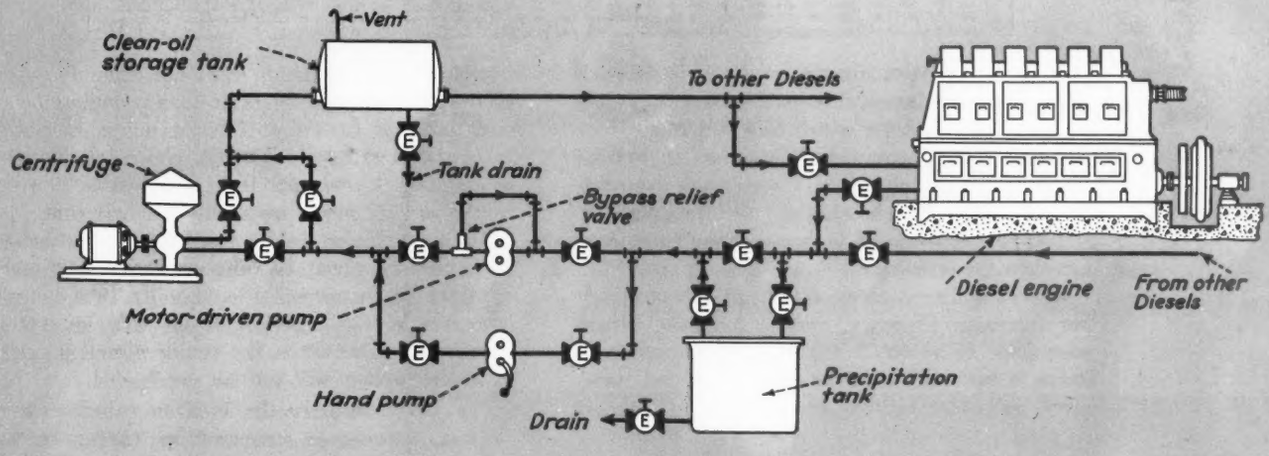
STARTING AIR



FUEL OIL



LUBE OIL



REFERENCE CHART FOR JENKINS FIGURE NUMBERS

		Standard	Medium	Extra Heavy
A	AIR COMPRESSOR GLOBE	BRONZE 106A Sc. Disc Type	BRONZE 750 Sc. Regrinding 950 Sc. Regr.-Renew	BRONZE 801 Sc. Disc Type 970 Sc. Regr.-Renew
	COMPRESSOR CHECK	BRONZE 54 Sc. Renew Seat Ring Comp & S/S Disc 55 Sc. Renew Seat Ring S/S Disc	BRONZE 54 Sc. Renew Seat Ring Comp & S/S Disc 55 Sc. Renew Seat Ring S/S Disc	BRONZE 54 Sc. Renew Seat Ring Comp & S/S Disc 55 Sc. Renew Seat Ring S/S Disc
B	STARTING VALVE QUICK OPENING	BRONZE 121 Sc. Disc Type Lever Handle 713 Sc. Disc Type Lever Handle	BRONZE 121 Sc. Disc Type Lever Handle 713 Sc. Disc Type Lever Handle	BRONZE 121 Sc. Disc Type Lever Handle 713 Sc. Disc Type Lever Handle
C	FUEL OIL TANK, PUMPS GATE	BRONZE 47 Sc. Travel. Spind. 370 Sc. Non-Rising IRON 325 Sc. Non-Rising 326 Fl. Non-Rising 650 Sc. O.S. & Y. 651 Fl. O.S. & Y.		
D	FUEL TO DIESEL GLOBE	BRONZE 106A Sc. Disc Type 750 Sc. Regrinding	BRONZE 950 Sc. Regr.-Renew 956 Sc. Regr.-Renew Plug Type	BRONZE 801 Sc. Disc Type 1140 Sc. Regrinding 1150 Sc. Regr.-Renew 970 Sc. Regr.-Renew 976 Sc. Regr.-Renew Plug Type
	ANGLE	BRONZE 108A Sc. Disc Type 752 Sc. Regrinding	BRONZE 952 Sc. Regr.-Renew 958 Sc. Regr.-Renew Plug Type	BRONZE 803 Sc. Disc Type 1141 Sc. Regrinding 1152 Sc. Regr.-Renew 978 Sc. Regr.-Renew Plug Type
E	LUBE OIL TANK, PUMPS GATE	BRONZE 47 Sc. Travel. Spindle 370 Sc. Non-Rising		
	GLOBE	BRONZE 106A Sc. Disc Type 750 Sc. Regrinding	BRONZE 950 Sc. Regr.-Renew 956 Sc. Regr.-Renew Plug Type	BRONZE 801 Sc. Disc Type 1140 Sc. Regrinding 1150 Sc. Regr.-Renew 970 Sc. Regr.-Renew 976 Sc. Regr.-Renew Plug Type
	ANGLE	BRONZE 108A Sc. Disc Type 752 Sc. Regrinding	BRONZE 952 Sc. Regr.-Renew 958 Sc Regr.-Renew Plug Type	BRONZE 803 Sc. Disc Type 1141 Sc. Regrinding 1152 Sc. Regr.-Renew 978 Sc. Regr.-Renew Plug Type

Motor operated Iron and Steel Valves can be supplied

JENKINS BROS., 80 WHITE STREET, NEW YORK, N. Y.

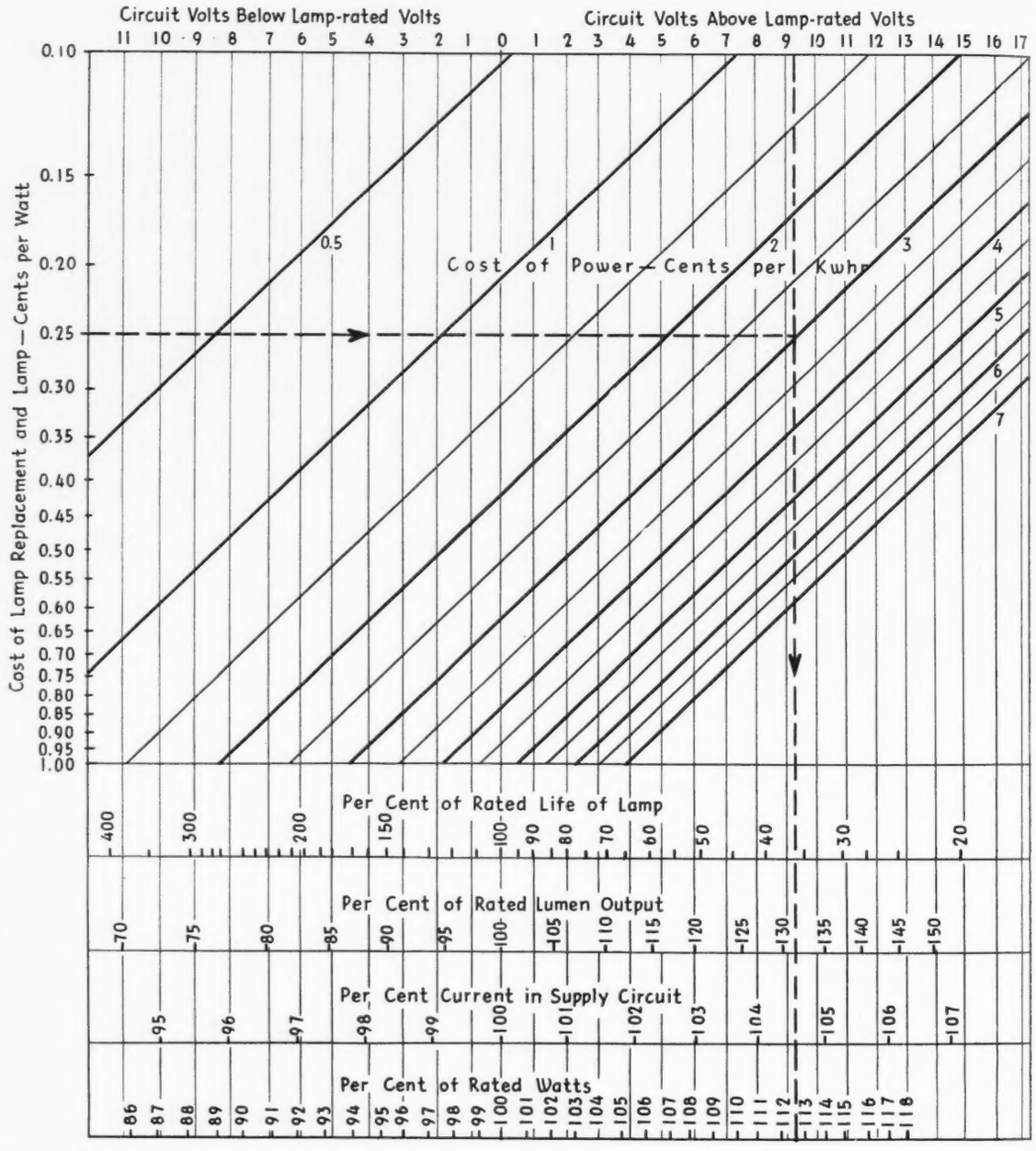
Bridgeport • Boston • Chicago — Philadelphia • Atlanta • Houston

1864—1939 DIAMOND ANNIVERSARY

#12 OF A SERIES designed to help in your selection of JENKINS VALVES

Number 89

Economical Lamp Voltage


Circuit Volts Below Lamp-rated Volts
Circuit Volts Above Lamp-rated Volts
Cost of Lamp Replacement and Lamp — Cents per Watt
Cost of Power — Cents per Kwhr
Per Cent of Rated Life of Lamp
Per Cent of Rated Lumen Output
Per Cent Current in Supply Circuit
Per Cent of Rated Watts

IMPORTANT CHANGES HAPPEN to life and efficiency of incandescent lamps if circuit voltage is higher or lower than that for which they are rated. It is not always most economical, however, to operate lamps at rated voltage, and sometimes considerable advantage can be obtained by changing voltage or buying lamps of higher or lower rated voltage than the circuit.

Operating lamps above rated volts shortens life but increases efficiency, and so becomes proper when cost of power is high and replacement of lamps is not too inconvenient. On the other hand, when lamp cost is high, for example in the case of silver-processed indirect units, or when longer life saves inconvenient or expensive replacements, or when power is cheap, perhaps low voltage is best.

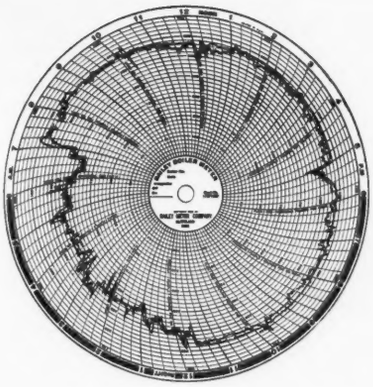
The chart quickly shows the approximate best voltage above or below rated for a range of power cost, and for any lamp cost. For example, if a 100-watt lamp costs 15 cents to buy and replacement labor is figured at 10 cents more, it should be operated at nearly 10 volts above rated where power costs 3 cents per kwhr, but nearly 10 volts below rated if power costs only one-half cent.

Auxiliary scales below the chart show that a lamp burning about 10 volts over rated lasts only one-third of its normal life (usually 1000 hours) but gives a third more light for only an eighth more power. Current in the supply circuit is given to assure wiring will not be overloaded.

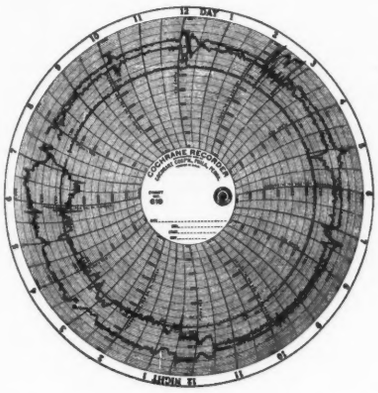
The chart can also be used to calculate how lighting intensity is increased by raising circuit voltage without changing lamp size or fixtures. On the other hand it may be found that a larger size lamp should be used and burned at reduced voltage to get longer life.

 By S A Tucker

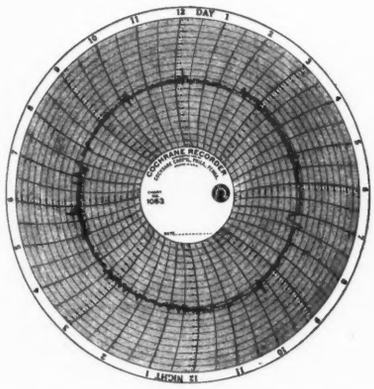
© POWER



Steam-flow-air-flow chart shows a typical day's load on The Derby Gas & Electric Company's Integral Furnace Boiler. Rated capacity is 125,000 pounds of steam per hour.

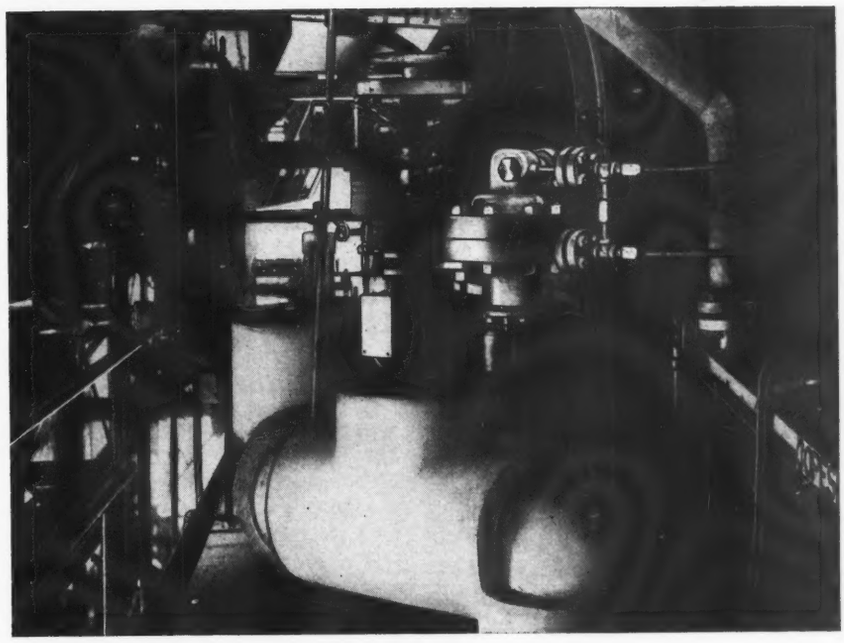


Water flow, middle curve, follows load accurately despite changes in water pressure, outer curve, while steam pressure, inner curve, holds constant at 675 pounds gage.



Water level is stabilized within close limits throughout the day. Maximum variation is only plus or minus one inch, with level rising slightly as load increases.

More than 100 COPES Flowmatics are giving good results on boilers from 130 to 1325 pounds W.S.P. For a complete description of this simplified steam-flow type feed water regulator, write for Bulletin 409-B.



Derby Gas & Electric Co.

"repeats" with COPES Flowmatic

Promises might sell a first order, but no progressive utility repeats with any equipment unless it has made good on the job. And The Derby Gas & Electric Company re-ordered COPES Flowmatic only after checking results of the first installation, shown above, on a 675-pound B. & W. Integral Furnace Boiler. Right from the start, water level has been held within plus or minus one inch. Feed flow has been exactly as needed for the loads. And the COPES Flowmatic has given these aids to safer, more efficient operation without offering any operating or maintenance problem of any kind. For proof of performance, check the charts at the left. For effective feed and level control on your modern boiler, specify the simplified two-element COPES Flowmatic Regulator.

NORTHERN EQUIPMENT CO., 1211 GROVE DRIVE, ERIE, PA.

Feed Water Regulators, Pump Governors, Differential Valves
Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS IN CANADA, ENGLAND, FRANCE, GERMANY AND ITALY
REPRESENTATIVES EVERYWHERE

★ GET CLOSER LEVEL CONTROL WITH THE FLOWMATIC ★ REGULATOR

Power Lines

Public Hearing on Dust-Collecting Code

With the increase in the rate of combustion in modern stoker-fired steam-generating units and the wide adoption of the pulverized-fuel method of firing, the necessity for removing the solid particles from the flue gas has increased. No standard or generally recognized method seemed to be available for determining the adequacy of dust-separating apparatus when installed in the power plant. Accordingly, the Power Test Codes Committee of The American Society of Mechanical Engineers, appointed a committee to be known as individual Committee No. 21, whose duty would be to draft a test code for dust-separating apparatus.

The committee has developed a code which it believes meets the needs of all groups, manufacturers, public utilities, governmental agencies, etc. However, the committee has decided to supplement its general distribution of tentative drafts of the code by a public hearing. This hearing has been scheduled for Monday, December 4, 1939, at 4:30 p.m. in the Bellevue-Stratford Hotel, Philadelphia, Pa., headquarters for the 60th Annual Meeting. Complete copies of the proposed ASME standard test code may be obtained from the Society's headquarters. All are cordially invited to attend this hearing whether or not they hold membership in the Society.

From any person, who for one reason or another cannot attend the hearing, Committee No. 21, the main committee, and the Society will welcome suggestions for corrections or additions to this tentative draft. These communications should be addressed to the chairman of the committee, in care of The ASME, 29 W 39th Street, New York, N. Y.

Container Corp Addition

Plans for an immediate expenditure of $250,000 for plant improvements at its Chicago Ogden Avenue paper mill have been announced by the Container Corp of America. Work will begin at once.

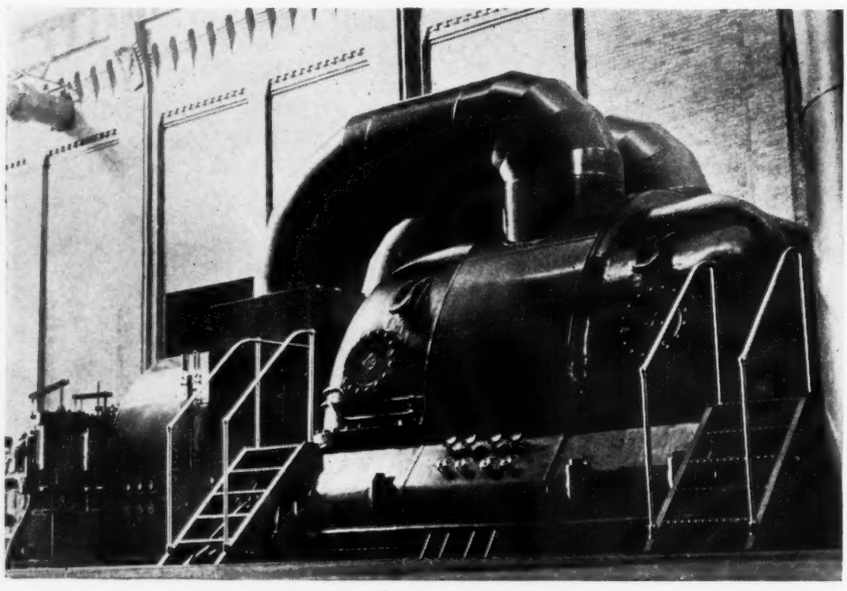
A new boiler installation, water-treating system, and buildings are included in the modernization program, which eventually will contemplate new turbines and an improved paper-making method. A new 75,000-lb-per-hr boiler will supplement an existing unit capable of like pressure. With these and other expected improvements power costs per ton of paper will be reduced while paperboard production will be increased.

Also announced at this time was an expenditure of $15,000 to install oil burners and a service tank at the corporation's Philadelphia plant, and $30,000 in water-supply improvements for the Circleville, Ohio, strawboard mill.

CIO Power Union Signs First Contract

The United Powerhouse Workers' Union, CIO, established in early November, has signed a closed shop contract with Ken land, Inc., a realty concern, which owns a powerhouse supplying the Larkin Co Inc plant, Buffalo, N. Y.

The agreement provides for the closed shop, a guarantee of no layoffs or discharge for "economy" during the life of the contract, wage increases ranging from 15 to 25 cents an hour, no transfers from one department to another and a reduction in the work week from 44 to 40 hours with the same pay.



IOWA'S NEWEST TURBINE

35,000-kw condensing turbine-generator built by Allis-Chalmers Mfg Co for Des Moines plant of Iowa Power & Light Co. Unit operates at 1290 lb, 925 F, 3600 rpm

790,000 Kw New Capacity Ordered Since Sept 1

Since the preliminary listing published in the November issue of POWER (page 120), about 400,000 kw of additional new orders have been placed, bringing the total over 790,000 kw ordered since September 1 through November 10. Utility purchases represent almost 90% of this figure, but many industrial orders, now on the fire, have not been announced for publication.

Utility	*Turbines*
Safe Harbor Susquehanna River, Pa.	25,000 kw*
Manchester St Providence, R. I.	40,000 kw
Commerce St Milwaukee, Wis.	35,000 kw
Chester Philadelphia, Pa.	50,000 kw
Westport Baltimore, Md.	50,000 kw
Marion Jersey City, N. J.	50,000 kw
Buck Salisbury, N. C.	80,000 kw**
John C Weadock Bay City, Mich.	35,000 kw
Bucksport Bucksport, Me.	12,500 kw
Mobile, Ala.	35,000 kw
Macon, Ga.	35,000 kw
Kansas City, Mo.	35,000 kw
St. Cloud, Minn.	7,500 kw
Alexandria, Va.	15,000 kw
Oswego, N. Y.	80,000 kw
Huron, S. D.	4,000 kw
Lauderdale, Fla.	25,000 kw
Cleveland, Ohio	60,000 kw
Glendale, Calif. (Municipal)	20,000 kw
Burbank, Calif. (Municipal)	10,000 kw
Springfield, Ill. (Municipal)	15,000 kw
Total	719,000 kw

**Hydroelectric unit*
***Number of turbines not known*

In addition, definite information has been released on 75,000 kw for industrial plants, making a grand total of 794,000 kw.

The 80,000-kw unit for Oswego Station of Central New York Power Corp is in addition to the present 80,000-kw installation now abuilding. Initial plant is scheduled for completion next spring; second unit will be finished in the fall of 1941.

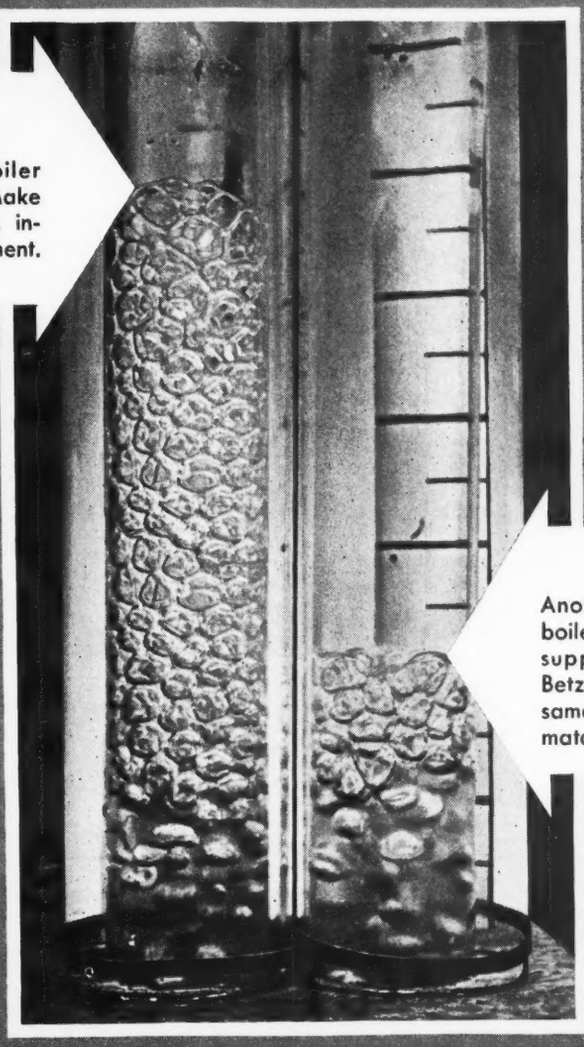
Lewis Institute to Merge With Armour Tech

The Armour Institute of Technology and the Lewis Institute, both of Chicago, have announced that their respective institutions will consolidate into a large technological center for Chicago. This is the first occasion on which two colleges of engineering have ever agreed to merge their interests to produce an institution of more important scope.

The name of the new school is to be Illinois Institute of Technology. Armour and Lewis have for many years served the community in the fields of engineering education, and, by this amalgamation, it is expected that this work and this service

Research Conquers
CARRY-OVER

BEFORE
Sample of actual boiler water, foaming badly. Make up lime-soda softened, internal phosphate treatment.



AFTER
Another sample of same boiler water with foaming suppressed by exclusive Betz method. Exactly the same heat applied to both matched cylinders.

Betz research has resulted in the startling comparison shown. Betz clients are enjoying these same results in their boilers. They are available to you.

W. H. & L. D. BETZ, 235 W. Wyoming Avenue, Philadelphia

Branch Offices at: 50 CHURCH STREET, NEW YORK • 37 W. VAN BUREN STREET, CHICAGO
WOOD INDUSTRIES, LTD., ROYAL BANK BUILDING, MONTREAL, QUEBEC, CANADA

Chemical Engineers Strategically Located

CONSULTATION • PLANT STUDIES • **BETZ** PLANT DESIGN • SERVICE SUPERVISION

Chemical Engineers and Consultants on All Water Problems

can be greatly enhanced to the benefit of the community.

The actual consolidation of the educational program will be complete by September, 1940, and the balance of this year will be given over to planning an integration of activities. For the time being, it will be necessary to operate both the Armour and Lewis plants, but the complete development of the new center of technology contemplates the acquisition of a new, well-planned campus, conveniently located, to meet the needs of its broad objectives.

New License Law for New York City Operators

Immediately below is published a local law recently enacted by the city of New York, covering qualifications of operating engineers. POWER readers in other cities and states, will be interested, because this will show them what they are up against if they plan to move to New York City, and secondly, it may suggest forms for laws in other cities.

Section 1. Subdivision d of section C26-213.0 of the administrative code of the city of New York is hereby amended to read as follows:

d. No person shall be eligible for such certificate of qualification as provided in this section, unless he shall

1. Be at least twenty-one years of age; and
2. Be a citizen of the United States; and
3. Be able to read and write the English language; and
4. Have been a resident of the city of New York for at least three years next immediately preceding the date of his application for examination; and
5. Have been employed as a fireman, oiler or general assistant to a duly certificated operating engineer in a building or buildings in the city of New York for a period of five years, of the seven years, immediately preceding the date of his application; or
6. Have served as a journeyman boilermaker or machinist engaged in the construction or repair of steam boilers or steam engines for a period of five years at least one of which shall have been under the supervision of a duly certificated operating engineer in the city of New York within the three years immediately preceding the date of his application; or
7. Have received the degree of mechanical engineer from a school or college recognized by the university of the State of New York and have had one year's experience in the operation and maintenance of stationary plants under the supervision of a duly certificated engineer in the city of New York; or
8. Be a holder of a certificate as engineer issued by a board of examining engineers duly established and qualified pursuant to the laws of the United States or any state or territory thereof, or a certificate as a marine engineer issued by the department of commerce of the United States, and have had one year's experience in the city of New York in the operation and maintenance of stationary plants under the supervision of a duly certificated operating engineer; provided that the applicant shall have filed with his application his own affidavit that he is the person named in said certificate together with supporting affidavits by three duly certificated operating engineers employed in the city of New York at the time of making of such affidavits.

Sec. 2. The administrative code of the city of New York is hereby further amended by adding thereto a new section to follow section C26-213.0, to be section C26-213.1 to read as follows:

§C26-213.1. Issuance of certificates; scope of examination. A certificate of qualification shall be issued to each eligible applicant who shall successfully pass a written examination consisting of practical questions on the operation and maintenance of steam boilers, engines, pumps and their appurtenances.

Cummins Engine Co Builds Addition

Cummins Engine Co, Columbus, Ind., has transferred the manufacture of diesel fuel pumps and injectors to a new 1-story rigid-frame building.

The new building, designed and erected by The Austin Co, contributes to high working efficiency by an even distribution of daylight through saw-tooth monitors, continuous side-wall sash and clear glass partitions. An installation of combination mercury vapor-mazda lighting units insures a minimum of 70 foot-candles at the working plane. Pumps and injectors are assembled in a sealed room where filters at the air-intakes insure absolute cleanliness required for this precision work. Other departments are similarly equipped.

Machining and grinding operations are concentrated in a large area where dust collectors have been installed. Plating is accommodated in a special glass-enclosed room in the center of the machining and grinding area. Louvres in the lower walls and a ventilator hood which completely caps the room and extends up through the building roof provide constant circulation which quickly disposes of vapors from the plating tank.

Meetings

American Institute of Electrical Engineers—*Winter Convention, January 22–26, Engineering Societies Bldg, New York, N. Y. H H Henline, Secretary, 29 W 39th St.*

American Society of Heating & Ventilating Engineers—*Annual meeting in conjunction with 6th International Heating & Ventilating Exposition, January 22–26, Lakeside Hall, Cleveland, Ohio. A V Hutchinson, secretary, 51 Madison Ave, New York, N. Y.*

American Society of Mechanical Engineers—*60th Annual Meeting, December 4–8, Bellevue-Stratford Hotel, Philadelphia, Pa. C E Davies, secretary, 29 39th St, New York, N. Y.*

American Society of Refrigerating Engineers—*35th Annual Meeting, January 16–18, Blackstone Hotel, Chicago, Ill. David L Fiske, secretary, 37 W 39th St, New York, N. Y.*

Louisiana Engineering Society—*45th Annual Meeting, January 12–13, St. Charles Hotel, New Orleans, La. A M Hill, secretary-treasurer, 422 St. Charles Hotel, New Orleans, La.*

Refrigerating Service Engineers Society—*Annual Convention, January 15–18, Chicago, Ill. H T McDermott, secretary, 433 N Waller Ave, Chicago, Ill.*

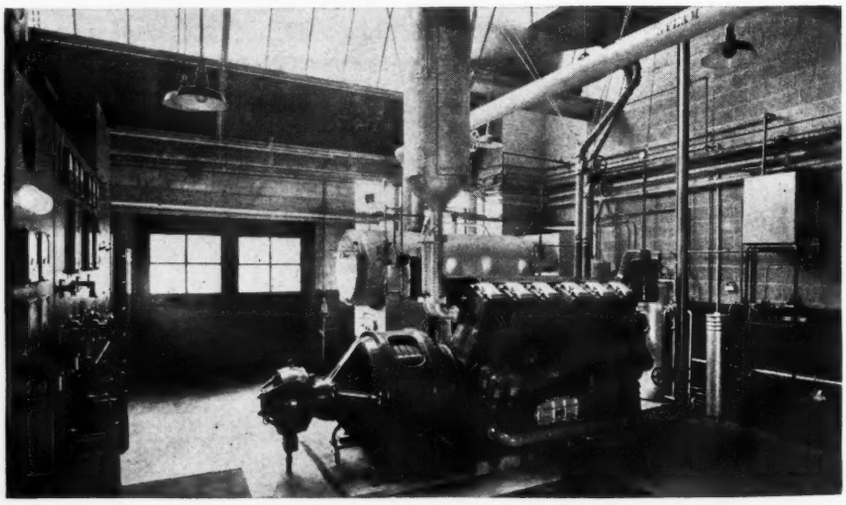
ASME Annual Meeting in Philadelphia, December 4-8

Dedicated to the peaceful purpose of broadening the usefulness of the mechanical-engineering profession, the 60th Annual Meeting of the American Society of Mechanical Engineers, to be held in Philadelphia at the Bellevue-Stratford Hotel, December 4-8, is the first annual meeting to be conducted outside New York City since 1890.

Besides a broad program of inspection trips, luncheons, smokers and get-to-gethers, many technical session of interest to power engineers have been arranged:

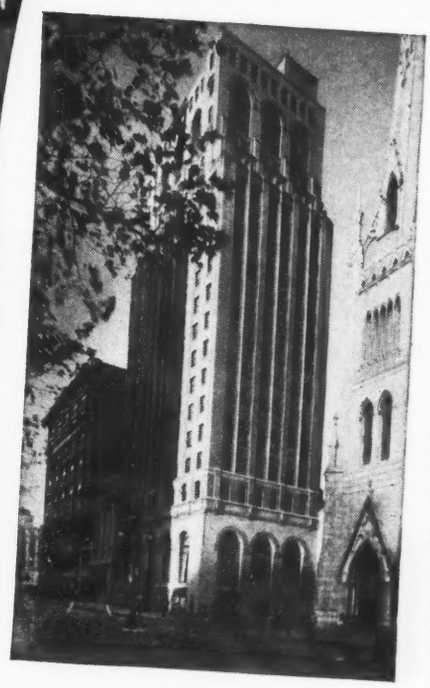
FUELS

"Which Fuel to Choose?" by G A Ambro.



Power for the new Cummins plant addition is generated by a 500-hp diesel direct connected to a 250-kw generator. A 1000-gal. storage tank fed from a larger tank adjacent to the main plant, provides fuel for the diesel and also for the oil-fired boiler which supplies heat through thermostatically controlled, unit heaters

For security from rusty water this Trust Company chose Everdur



Liberty Title & Trust Company Building, Philadelphia, Pa., recently installed this new WHITLOCK Everdur Type K heater, 36″ x 96″, made by THE WHITLOCK COIL PIPE CO., Hartford, Conn. It replaced a rusted-out heater which had served for 12 years. Because Everdur is absolutely rust-proof and highly corrosion-resistant, it is ideal for the job, assuring plenty of rust-free hot water indefinitely.

MORE efficient water heating is a fast-increasing trend in modern buildings and plants everywhere. This is one reason why more Everdur heaters are installed in a week than were built in the entire year 1929—each one destined to justify its selection by providing rust-free hot water service long after a heater of rustable metal would be discarded.

Strong, Rustless, Weldable

Everdur—a copper-silicon alloy—is rustless as copper, yet it has the tensile strength of mild steel. Also, it is easily welded and reasonable in price. Tanks and heaters of this unusual metal are available for every purpose from leading equipment manufacturers. 3962

Everdur TANK METAL ANACONDA from mine to consumer

THE AMERICAN BRASS COMPANY, General Offices: WATERBURY, CONNECTICUT
In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont. • *Subsidiary of Anaconda Copper Mining Co.*

EVERDUR is a trade-mark of The American Brass Company, registered in the United States Patent Office.

"Modern Methods of Fuel Purchasing," by R G Rincliffe. "Characteristics of Cloth Filters on Coal-Dust Air Mixtures," by A R Mumford, A A Markson, and T Ravese. "Defining Equitable Limits of Dust Emission From Stacks," by P H Hardie.

PRIME-MOVER REGULATION

"Hydraulic Turbine Governing," by W M White. "Power Swings in Hydroelectric Power Plants," by W J Rheingans. "Generator Characteristics as Affecting System Operation," by Sherwin H Wright. "Steam-Turbine Governors," by Reed J Caughey. "Constant System Speed and the Steam-Turbine Governor," by A F Schwendner.

POWER

Panel Discussion on Two Years' Experience With High-Pressure, High-Temperature Superposed Power Installation, led by E B Ricketts. "Two Years of Experience With High-Pressure, High-Temperature Equipment at Waterside Station," by J C Falkner. "Fisk Station Topping Unit Operation, October, 1937, to August, 1939," by A E Grunert. "Logan Operating Experience," by Philip Sporn. "High-Pressure, High-Temperature Superposed Power Installation at Omaha Station of Nebraska Power Co," by Louis Elliott.

LUBRICATION

"The Influence of Crystal Size on the Wear Properties of High-Lead Bearing Metal," by John R Connelly. "Temperature Distribution in Bearings," by E S Pearce. "Boundary Film Investigations," by S J Needs. "Properties and Performance of Plastic Bearing Materials," by L M Tichvinsky.

HEAT TRANSFER

"Laminar-Flow Heat Transfer," by R H Norris and D D Streid. "Heat Transfer to Falling-Water Films," by W H McAdams, T B Drew, and G S Bays, Jr. "The Calculation of Heat Transfer in Cross-Flow Exchangers," by E A Schumann. "Mean Temperature Difference in Design," by W M Nagle, A C Mueller, and R A Bowman. "Forum Discussion on Testing of Heat-Transfer Equipment," led by H C Hottel.

SYSTEM REGULATION

"The Field of System Governing," by Albion Davis. "Regulation of System Load and Frequency," by Herbert Estrada and Henry A Dryar. "Operating Experiences in System Speed Regulation," by O Holden.

PIPING

"The Significance of, and Suggested Limits for, the Stress in Pipe Lines Due to the Combined Effects of Pressure and Expansion," by D B Rossheim and A R C Markl.

INDUSTRIAL INSTRUMENTS AND REGULATORS

"Thermostatic Bimetals," by S G Eskin and J R Fritze. "Automatic Control in the

(*Continued on page* 138)

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Colo., Denver—National Biscuit Co., 19 and Blake St., plans constructing large bakery plant. E. 40 Ave., and Steele St. $1,000,000. L. Wirshing, 449 W. 14 St., New York, mgr. Company's Building Dpt.

Conn., Bridgeport—United Illuminating Co., 1119 Broad St., plans constructing 25,000 kw. addition to Steel Point Power Station, East Main St., Bridgeport Harbor. Over $40,000. Westcott & Mapes, c/o W. F. Thompson, 139 Orange St., New Haven, engrs.

Idaho, Rupert—Bureau Reclamation, Custom House, Denver, Colo., sketches constructing new L-shaped power house addition to federal power plant at Minidoka Dam. S. A. McWilliams, Rupert, resident engr.

Ind., Fort Wayne—Bids Nov. 28, by Bd. P. Wks., R. G. Beams, chn., City Hall for light and power plant improvements, incl. 15,000 kw. turbo-generator set, $353,500; surface condenser, $67,200. Bids later on appurtenant equipment. $138,900. Total est. $560,000. O. Adams, supt. Light Dpt., c/o owner.

Ind., Logansport—Bd. P. Wks., E. M. Hoyt, secy., City Hall, soon takes bids constructing power plant improvements, high pressure steam piping. Total est. $50,000. C. Ammerman, 772 Century Bldg., Indianapolis, engr.

Ia., Brooklyn—F. J. Gates, mayor, and J. Schmitz, city clk., voted bonds to construct light and power plant, and equipment, accessories and appurtenances, etc. $135,000.

Ia., Cedar Falls—City plans constructing municipal hydro-electric plant on Cedar River. C. Streeter, city engr.

Ia., Fort Dodge—Fort Dodge Bottling Wks., plans constructing plant. $150,000.

Ia., Greenfield—Bids Dec. 12, by Town, improving electric light and power plant, Sect. 3 power plant building extension, Sect. 4, piping and auxiliary equipment, Sect. 5, electrical work. Stanley Eng. Co., Muscatine, engrs.

Ia., McGregor—City approved $120,000 bonds, constructing municipal light plant. Stanley Eng. Co., Muscatine, engrs.

Ia., Oelwein—City making plans constructing municipal electric light and power plant, Hubbard Eng. Co., 415 N. LaSalle St., Chicago, Ill., engrs.

Md., Vienna—Eastern Shore Public Service Co. of Delaware, Salisbury, Md., and c/o Utility Management Corp., 61 Bway., New York, (incl. Delmarva Power Co. and Maryland Light & Power Co., owned by above) plans expansion and remodeling generating plant, installing 7,500 kw. turbine unit and laying base for second of similar capacity. $600,000. E. M. Gilbert Eng. Corp., 412 Washington St., Reading, engrs. (**Correction**—Owner's address)

Miss., Jackson—General Electric Co., River Rd., Schenectady, N. Y., plans constructing plant for manufacturing headlights and lamps. $750,000.

Mo., St. Louis—Blanton Co., D. A. Blanton, pres., 318 S. 2 St., soon takes bids constructing six 1 and 2 story, plant buildings, incl. office, garage, power plant and 3 factory buildings for oleomargarine plant. $400,000. W. J. Knight & Co., Wainwright Bldg., engrs.

Neb., Hastings—Preliminary study made, improving municipal power plant, installing new turbine-generator unit, boiler and auxiliaries, switchgear, etc. Black & Veatch, 4706 Bway, Kansas City, Mo., engrs.

N. H., Concord—State Hospital, Dr. C. Dolloff, supt., Pleasant St., making plans altering, constructing, 1 story, brick, steel, power and steam plant addition, concrete foundation at State Hospital. $100,000. R. D. Kimball Co., 6 Beacon St., Boston, Mass., engrs.

N. J., New Brunswick—Johnson & Johnson, 500 George St., soon lets contract constructing 1 story, 300x600 ft. plant. $800,000. R. G. Cory, 30 Church St., New York, N. Y., engr.

N. Y., Oswego—Central New York Power Co., Electric Bldg., Buffalo, plans constructing steam generating plant unit. $7,000,000. Burns & Roe, Inc., 233 Bway., New York, engrs.

N. Y., Rochester—Rochester Gas & Electric Co., East Ave., plans constructing generating plant at Station 3. $847,924. E. M. Gilbert Eng. Corp., 412 Washington St., Reading, Pa., engrs.

N. C., Salisbury—Duke Power Co., 422 S. Church St., Charlotte, will construct 100,000 hp. steam-power plant, at Dukeville, near here, by own forces. $6,000,000.

O., Cleveland—Cleveland Electric Illuminating Co. W. H. Hartman, purch. agt., 75 Public Square, plans by E. Rhods, 75 Public Square, constructing 1 story, brick, steel, concrete electric power plant E. 70 St. and Lakefront Rd. to house 60,000 KW turbo-generator, 2 boilers, ash precipitation equip., screenhouse, etc. $1,500,000 for building construction. Total est. $6,300,000. Taking bids on boilers.

O., Fostoria—Swift & Co., 4115 S. Packers St., Chicago, Ill., plans constructing soybean mill, 14 storage elevators, capacity 400,000 bushels, on site opposite Fostoria Country Club. Over $200,000. Site purchased.

O., Monroeville—C. Zitfel, mayor, plans constructing municipal electric light plant. $78,000. W. C. Kammerer & Assoc., 1900 Euclid Ave., Cleveland, engrs.

O., Newark—Borden Co., 350 Madison Ave., New York, N. Y., plans by H. Eiselt, 297 South High St., Columbus, constructing 1 story, 80x128 ft., brick, concrete dairy plant, South Third and Walnut Sts. $125,000.

O., St. Marys—Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, receives bids in about 30 days, constructing 2 story brick, steel, concrete building for manufacturing pliofilm. $800,000. Private plans.

O., Troy—Hobart Mfg. Co., W. Hartley, factory mgr., plans constructing power plant addition, installing 50 hp. steam boiler. $75,000. W. E. Barrows, 1164 Reibold Bldg., Dayton, engr.

Ore., Tongue Point—Bids Nov. 28, by P. Wks. Officer, Puget Sound Navy Yard, Bremerton, Wash., constructing seaplane hangar, storehouse, shop buildings and power plant building for Naval Air Station, Spec. 9482.

Pa., Johnstown—Johnstown Sanitary Dairy Co., plans constructing 3 story, bsmnt., brick, steel, concrete dairy products plant, Kernville section. $150,000-$200,000 with equipment. Private plans.

Pa., Phila.—Philadelphia Electric Co., H. P. Liversidge, pres., 1000 Chestnut St., plans constructing Southwark Station, 500,000 kw. capacity, along Delaware River, Oregon Ave., South Phila. $45,000,000.

Tenn., Franklin—Harpeth Valley Chemical Co., c/o J. H. Kresge, 400 Warner Bldg., Nashville, plans constructing phosphate plant. $125,000.

Tex., Beaumont—Pennsylvania Shipyard, Inc., Beaumont, plans improving shipyards plants, expanded facilities, etc. $250,000. Preliminary work started by owner.

Tex., Corpus Christi—Bids Nov. 25, by Central Power & Light Co., G. Gilliam, div. mgr., constructing concrete, steel, brick main power plant building. $300,000. Total est. $1,000,000. J. T. Persons, ch. engr. of owners. Sargent & Lundy, 140 S. Dearborn St., Chicago, Ill., designing engrs.

Tex., Kermit—El Paso Natural Gas Co., Basset Tower, El Paso, c/o C. C. Cragin, plans constructing steel absorption plant, 50,000 gal. daily capacity. $1,000,000.

Va., Alexandria—Virginia Pub. Service Generating Co., J. M. Costello, secy-treas., plans constructing steam generating plant. $2,000,000.

Va., South Boston—Carter Fabric Corp., Greensboro, N. C., plans constructing rayon weaving plant on 219 acre tract, Belt Farm, east section of town. Building $300,000, equipment. $500,000.

Wash., Seattle—Currin-Greene Shoe Mfg. Co., 2715 Western Ave., plans constructing 3 story, 60x120 ft. rein.-con. factory addition. $125,000.

W. Va., Benwood—Wheeling Steel Corp., Wheeling Steel Bldg., Wheeling, plans constructing within the next few weeks buttweld mill. $1,000,000. Private plans.

W. Va., Follansbee—Follansbee Bros. Co., 3rd and Liberty Sts., Pittsburgh, Pa., plans modernizing plant. $1,200,000. Private plans.

Wis., Genoa—Bids about Dec. 1, by Tri State Power Co-operative, 312 Rivoli Bldg., LaCrosse, constructing rein.-con., brick power plant, piping and exchange equipment. $275,000. A. Y. Taylor & Co., Central Bldg., 2 South Central St., Clayton, St. Louis, Mo., engrs.

B. C., New Westminster—B. C. Plywoods Ltd., H. R. MacMillan, pres., 7 Cromwell Ave., Vancouver, plans constructing additional plant unit. $200,000. Architect, c/o owner.

B. C., Vancouver—Vancouver Rayon Silks, Ltd., Vancouver, takes bids in December, constructing 1st unit rayon silk plant, North Vancouver. $500,000. Ultimate cost $2,500,000. Private plans.

Ont., Brantford—C. A. Waterous, chn. Public Utilities Comn., plans constructing power plant extension. $50,000. F. P. Adams, City Hall, engr.

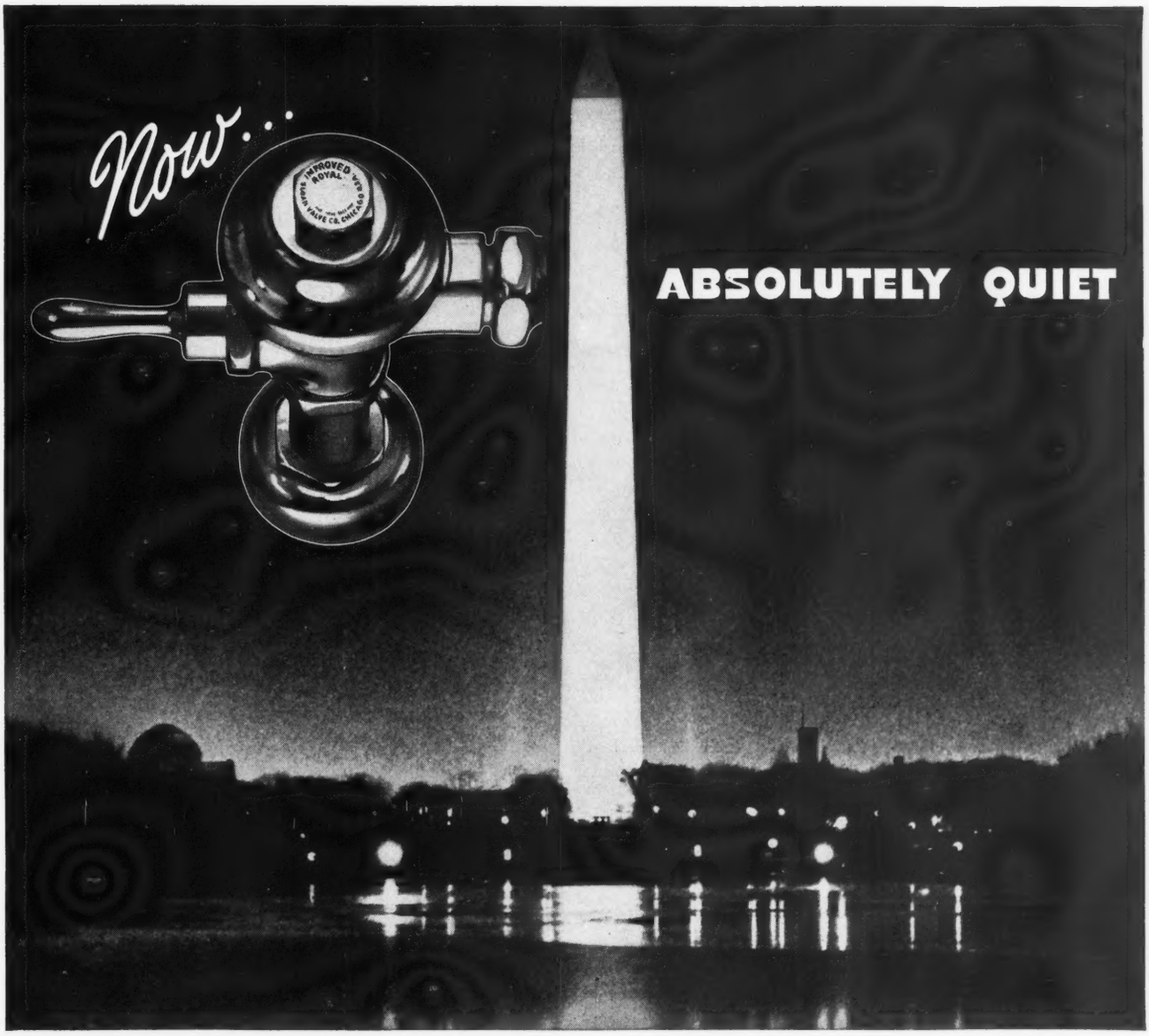
Ont., Malton—National Steel Car Corp., Ltd., Kenilworth St. N., Hamilton, plans constructing brick, steel addition to aircraft plant, plain foundation at airport. $200,000. N. Wagner, c/o owner, engr.

Ont., Niagara Falls—Niagara Falls Power Comn., C. D. Hanniwell, mayor, making plans constructing auxiliary substation, Glenview St. J. E. Techoe, supt.

Ont., Ottawa—Lockheed Aircraft Corp., c/o D. K. McTavish, K. C., 56 Spark St., plans constructing airplane manufacturing plant. $200,000. Negotiating for site.

Ont., Port Robinson—Mark Dirigible Torpedo Development Co., Ltd., c/o C. S. Ross, Port Robinson, plans constructing plant, on 16 acre site Lot 31, $200,000. Site purchased. Engineer c/o owner, engr.

Que., Quebec City—Municipality made plans constructing diesel electric power plant. $210,000. E. Hamel, City Hall, engr.



No longer need flush valves be annoyingly noisy. They can be absolutely quiet. Indeed, the Sloan *Quiet-Flush* Valves *are* absolutely quiet. Sloan *Quiet-Flush* Valves are available in the Royal, Star, Crown and Naval models.

Moreover, *any* Sloan flush valve in the above models, may be made absolutely quiet —regardless of when installed. Merely replace the present stop valve with the redesigned Sloan stop, then insert in the valve itself a new type guide and seat. This simple change, readily made by any master plumber, reduces the roar of rushing water to a murmur —and virtually makes your old valve a brand new installation.

Build customer goodwill by giving them the world's most universally used flush valve —plus absolute quiet.

SLOAN VALVE COMPANY • CHICAGO
4300 WEST LAKE STREET

SLOAN *Quiet Flush* VALVES

Keep Yelling! . . .

Let me not put any notions that are harmful in your head,
But the baby that keeps yelling is the baby that gets fed.
—Old Jingle

PEOPLE SURE ARE PECULIAR. Europe starts a name-calling war. Over here, everybody rushes to buy. A lot of 'em lay in stocks of sugar and flour. In industry, inquiries that have been hanging fire for months or years suddenly become orders—and every department head around the plant asks for something to help fill 'em. Next-year deliveries are quoted. Production wants ten new lathes or five new millers, Maintenance wants a new fence "in case we get a munitions order", Engineering wants some new drafting tables and night lights. Among them all, there's a good chance that your standing request for a new turbine will go unnoticed. Theirs are dramatic requests tied in with the surge in business; yours is something you've "always been yelling for."

This is just a note to tell you to keep on yelling harder than ever. When they get their new lathes or millers, will there be power available to run them? The same situation that makes it hard to get deliveries on machine tools makes it hard to get ordered power equipment—and the power units take lots longer to install. But you'll still get the blame if the push comes and there's "no juice".

The whole thing reminds me of the stunt the engineer of a big hotel pulled to get attention. He'd been asking for a diesel for standby but had been pushed aside repeatedly. Radios for the rooms to be sure—but the diesel went into a department the customers never saw. So one night about three o'clock he just pulled the master switch. Hall lights went out, elevators stopped, the laundry and kitchens began to holler. After a few tense minutes, the chief threw in the switch—and then the hook. "Look," he said, "That could happen right at the rush hour and start a riot in the Blue Terrace. It might not be so easily fixed either, so you'd lose a whole evening—or two evenings and nights—of income. How about that new standby diesel?"

He got it. I'm not offering this as the way to do it—but keep yelling. That avoids the later shout from the Boss, "Why didn't you tell me you needed something?"

George Edwards

Engineer

SAFE STOPS

feather Soft

STOP! A crane-load of steel shapes. A hoist car crowded with men. The huge gate locks which hold a surging river. These plunging forces are controlled by a giant hand, brought to a safe, *cushioned* stop—by magnetic brakes perfected by Cutler-Hammer.

In Milwaukee, Cutler-Hammer engineers tested many compositions under severest service conditions to find a satisfactory brake-wheel material. On the basis of both cost and performance cast Nickel-manganese steel was selected. For added toughness, strength and wear resistance, this Nickel alloy steel is oil hardened to a Brinell hardness of 352-429.

New, unique ball jack in C-H brake is of high Nickel-Molybdenum steel. You can depend on alloys reinforced with Nickel to hold the load—and to hold down yearly costs. Please write for information.

(ABOVE) Cutler-Hammer magnetic brake, type TM, AC torque motor operated. Friction bands are forced against a cast Nickel alloy steel brake-wheel for cushioned stops.

NICKEL ALLOY STEELS

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N.Y.

The "BRIDGE-MEG" RESISTANCE TESTER

—a combined "MEGGER" Insulation Tester and Wheatstone Bridge

"MEGGER"

TRADE MARK REGISTERED U.S. PAT. OFF

For industrial and other engineers who have electrical equipment to install and maintain—here is a complete resistance-measuring outfit all packed into one portable set that weighs only about 13 lbs. With it you can test the insulation of all types of electrical equipment and detect and forestall trouble. You can measure coils, contacts and relays. You can locate many troublesome faults. The set is portable and rugged—built for every day hard use.

Let us tell you more about this unique instrument that has the remarkably wide range of .01 ohm to 200 megohms. Self-contained constant-pressure generator rated 250, 500 or 1000 volts d.c. Write for descriptive Bulletin 1615-P.

JAMES G. BIDDLE CO.

1211-13 Arch Street Philadelphia, Pa.

"We do not see how any Plant Maintenance Department can afford to be without one" —says the Electrical Engineer of a Paper Company.

Weighs 13 lbs.

Engineers' Books

(*Continued from page* 118)

this table and in the current report the number of plants reported for 5 successive years or over has reached 85.

Data on engine details and operating information are given in Table III, which includes, in addition to engine data, information on lubrication, fuel, engine loading, cooling systems, waste-heat utilization, maintenance and repairs, enforced shutdowns, and attendance labor.

Stationary Engineering

A TEXTBOOK FOR STATIONARY ENGINEERS (New and revised edition, 1939). *By W G Beaver, The School of Stationary Engineering, Hamilton, Ontario. Published by David McKay Co, Washington Square, Philadelphia. 276 pages, 5 x 7½ in., charts and problems, flexible binding. Price $2.50.*

This book is written expressly for men desiring to prepare for license examinations as given in the various provinces of Canada. However, much of the material will be useful to men preparing for examinations in the United States. The range of subject matter covered is as wide as the field of stationary engineering and covers combustion, steam boilers, pumps, steam engines, lifting machines, air compressors, turbines, electricity, power factor, refrigeration, steam heating, and metering.

Naturally, with so much ground to cover, the treatment is highly elementary and because of the great need for condensation, there are occasional statements which are not strictly accurate. Nevertheless, the author has, on the whole, presented the fundamentals of stationary engineering in a way that should prove helpful to beginners in the field.

Business Letters

HOW TO WRITE BETTER BUSINESS LETTERS (1940). *By L E Frailey, Lecturer, Author and Business Letter Counselor. Published by American Technical Society, Drexel Ave, at 58th St, Chicago, Ill. 198 pages 5½x8 in., cloth binding. Price $2.00.*

A pet complaint of power engineers against business managers is that the latter are slow to provide funds for worthwhile plant improvements. Probably a lot of the fault is with the engineer and the way he tries to put over his ideas. If they could write better business letters, engineers might go a long way towards getting better reception for their propositions and themselves. After all, management is human and likes to know that the man who has an idea, thinks enough of and about it to do a good selling job.

This book is not only helpful in its chief purpose, better business letters, but it is beautifully and entertainingly written. It is filled with actual samples of modern business letters of all types and

Private Letters OF AN OLD ENGINEER

No. 3
OF A SERIES
(A Scovill Service to You)

Dear Dick:

The tube failure problem outlined in your letter is one I can't answer, since nothing of that nature has ever occurred in our plant.

However, I do know that whenever I get stuck on a tube problem, I call in Scovill.

I have a friend nearby on the coast who was experiencing inlet end tube failure apparently as a result of air being entrained in the circulating water. An air-bound inlet circulating water tunnel was suspected, but a study of the blueprints of the plant layout failed to reveal any such condition.

However, Scovill engineers were called in and they found out that the air bound condition was caused by the plugging of a small vent at the time of an unusually high tide!

So the plug was removed and a new vent installed high enough above the tide. Instead of adopting a new expensive alloy (which was originally considered the solution to the problem), tube life was tripled just by this change in vent location.

Yes, I'd call in Scovill. They have a group of engineers as fine as any in the field, and you can thoroughly depend on their product and recommendations.

While I haven't given you a specific answer to your problem, at least I think I have shown you the way to get one. Best of luck.

Bill

Scovill Condenser Tubes, a booklet, will be sent free on request. Write to 13 Mill Street, Waterbury, Connecticut.

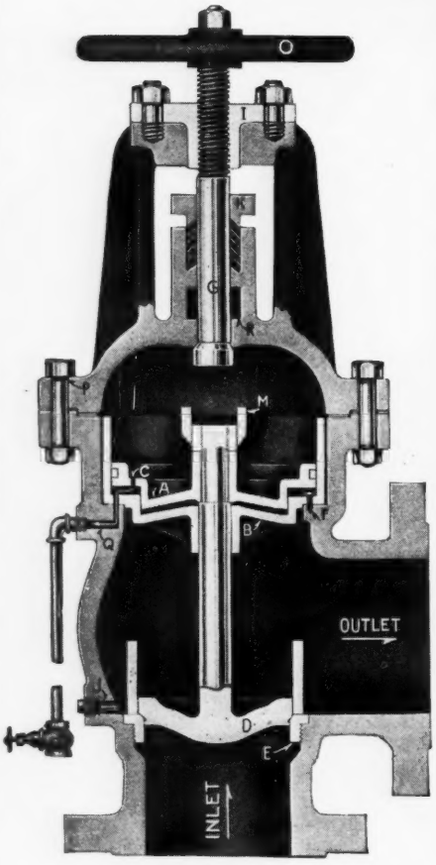
SCOVILL Masters of Metal

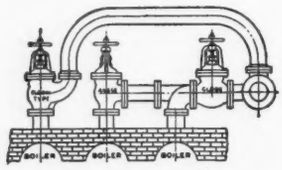
SCOVILL CONDENSER TUBES

one product . . . three services

PRODUCT ENGINEERING FIELD ENGINEERING ENGINEERING DATA

Golden Anderson
SPECIALTY
VALVES





NON-RETURN

When a tube bursts in one boiler, the contents of every boiler in that battery are coming through that rupture, *unless* there's a *good* non-return valve there to stop it. Guard against such destruction by installing an efficient, non-return valve that *will not* and *cannot* stick—like the G-A non-return valve illustrated here. To the best of our knowledge, none of the thousands in use has ever failed.

Protect the most valuable thing in the world—human life—with G-A non-return valves.

● WRITE FOR CATALOG

Also

Altitude Control . . .
Pressure Reducing . . .
Throttle and Emergency Stop . . . Check Valves etc.

GOLDEN-ANDERSON VALVE SPECIALTY CO.
FULTON BLDG. PITTSBURGH, PA.

explains just why and how these letters were written.

If you do not want a book on letter writing, then read it for its good health, humor, human understanding and inspiration. Reading the book will make you want to be more human and understanding in your dealings with other people, which is one of the most important elements in good letter writing.

Economics

APPLIED ECONOMICS FOR ENGINEERS (1939). *By Bernard Lester, Westinghouse Electric and Manufacturing Co. Published by John Wiley Sons Inc, 440 4th Ave, New York, N. Y. 462 pages, 6x9 in., numerous charts and tables, cloth binding. Price $4.00.*

Whether he likes it or not, the average engineer has to know something of the workings of the economic system if he is to be successful in his field. Unless fitted by special training or gifted with unusual insight, he can find little illumination in the standard texts on economics. He must turn to books written with his special problem in mind, of which the above book is a fine example.

In straight-forward language, and with constant illustration from the fields of production familiar to the engineer, Mr Lester takes our business structure apart, exposes the elements for closer view, points out the basic principles involved, and reassembles the structure in a way to show the engineer's peculiar place in it. Because of the tremendous amount of ground covered, analysis of individual items such as statistics and accounting methods, training and safety, purchasing, selling and pricing, must be brief. The chief virtue of the book lies in its completeness and the logic and simplicity of its construction. Reading it will give a clear comprehensive picture of present-day manufacturing and distribution, and indicate many lines for further investigations in books written by and for specialists.

Metal Cutting

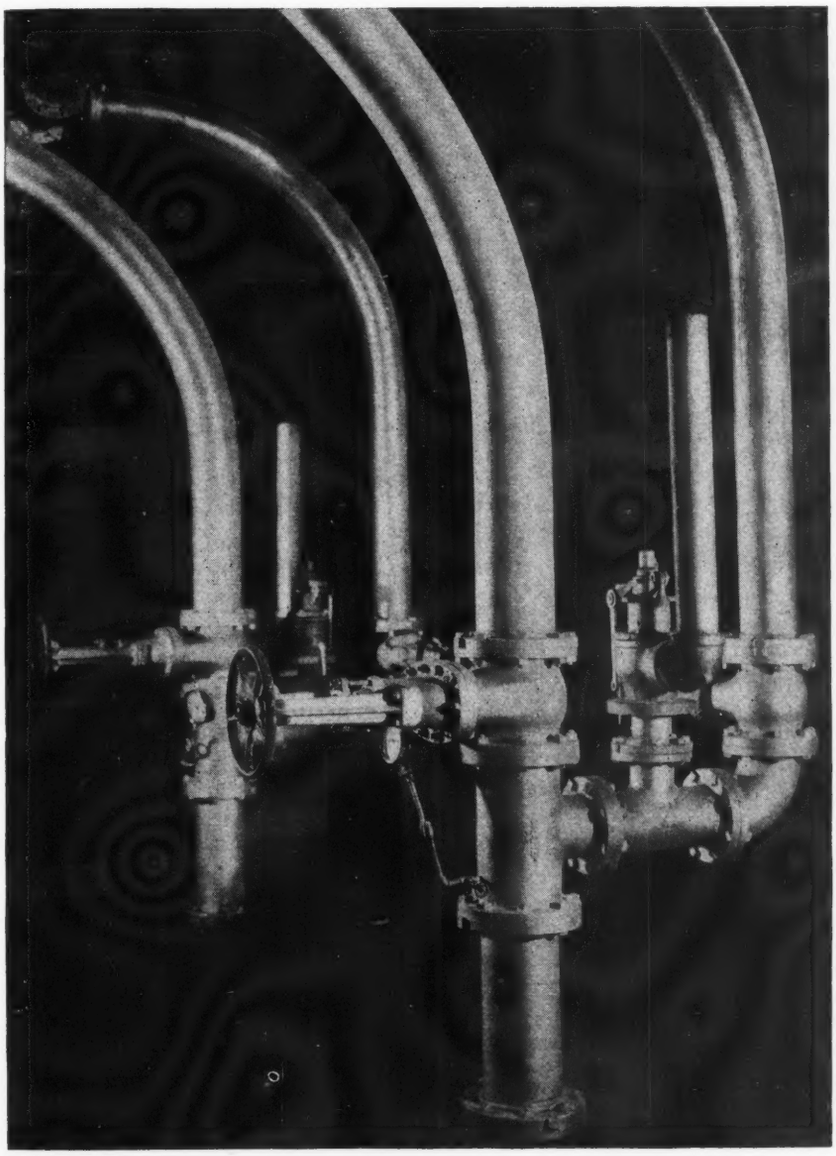
MANUAL ON CUTTING OF METALS—Single-Point Lathe Tools (1939). *Prepared by ASME Committee on Metal Cutting Data. Published by the ASME, 29 West 39th St, New York, N. Y. 319 pages, 5½x8½ in., 36 tool sketches, 340 tables. Bound in limp red leatherette, gold lettered, rounded corners. Price $5.00.*

Intended mainly for the high-production shop, this volume will also be of interest to power engineers and maintenance foremen who handle substantial amounts of lathe work and wish to cut machining time to a minimum.

This is not an elementary instruction book on lathe operation. Rather it gives scientific instructions for tool grinding and all the data necessary (shape, angles, cuts, feed, speed, etc) to get the most out of any given tool metal cutting on any given work metal.

Much of the book is devoted, therefore, to tabulations. Subjects covered include: Tool materials, shape, size and grinding;

Power Piping at its Best



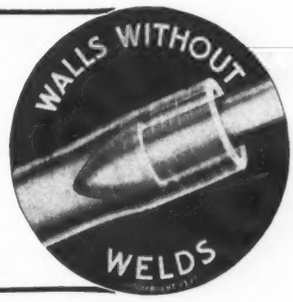
. . . *that's*
NATIONAL SEAMLESS PIPE

AMONG power plant engineers and consultants, there is one standard of comparison for power piping—and that is NATIONAL Seamless Pipe. For years, this strong, uniform pipe has remained in a class by itself. No other pipe has ever been able to offer a higher degree of safety and workability, or greater length of service.

That's why NATIONAL Seamless Pipe has won, and held, the confidence of men experienced with the handling of steam at high pressures and temperatures. Today, you'll find this pipe serving safely and economically in industrial and utility power plants the country over. Send for Bulletin No. 10.

Pierced from Solid Steel

Only the finest, most perfect steel billets obtainable can be used in the making of NATIONAL Seamless Pipe. For even the slightest point of weakness is sure to reveal itself in the piercing process. Since this pipe is produced entirely by piercing, rolling and forging, the result is "Walls Without Welds." Tough, strong, weld-free walls of solid, highest-quality steel. You can depend on NATIONAL Seamless Pipe properly installed, to give years of reliable service. It is the most widely used and generally accepted pipe in the power industry.



NATIONAL TUBE COMPANY

PITTSBURGH, PA.

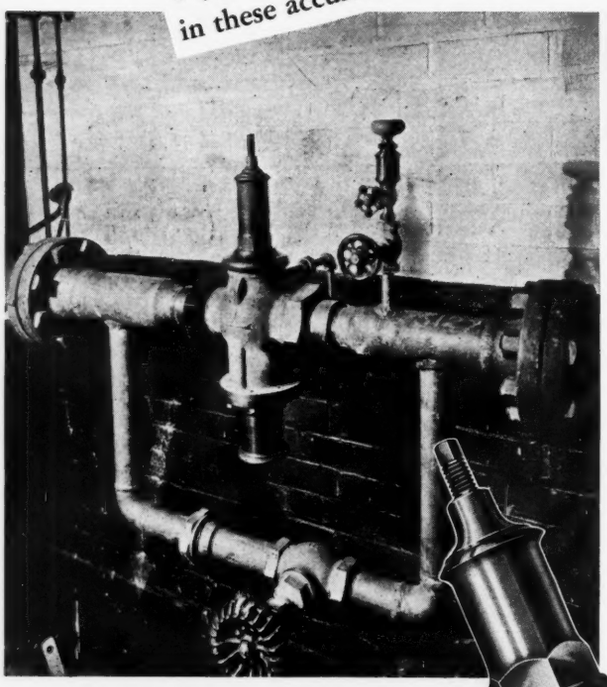
Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York, *Export Distributors*

UNITED STATES STEEL

LONGER LIFE LESS MAINTENANCE

is offered power engineers by Masoneilan No. 11 Reducing Valves. Heat treated stainless steel pilot and main valves and seats reduce erosion, corrosion, steam cutting and wire drawing to a minimum—cuts maintenance costs as much as 67%. And this trim costs no more—is standard in these accurate, pilot operated regulators.

FOR FURTHER INFORMATION SEE OUR CATALOG IN SWEET'S



A No. 11 Reducing valve holding accurate reduced pressure in an eastern industrial plant

Features that Mean Better Control

- Wide range of adjustability without spring change.
- Unaffected by fluctuating initial pressure.
- Extremely sensitive.
- Has tight shut-off.

SPECIFICATIONS: Bronze bodies—union ends—sizes ½ to 2". Iron bodies—flanged—sizes 2½ to 4". Steel bodies—flanged—1½ to 4". Maximum working pressures from 250 to 600 lbs. Ranges between 5 and 300 lbs. Select Masoneilan Regulators for all pressure reducing or back pressure service—the engineered equipment that is "Built Up to the Job." See Section 17/10 in Sweets or write for Catalog No. 39.

MASONEILAN

MASON-NEILAN REGULATOR CO.
1186 ADAMS STREET, BOSTON, MASS., U.S.A.

NEW YORK BUFFALO PHILADELPHIA PITTSBURGH
TULSA TOLEDO CHICAGO ST. LOUIS HOUSTON LOS ANGELES
MASON REGULATOR COMPANY OF CANADA, LTD., MONTREAL, CANADA

cutting fluids, setup, chatter, economic life and proportion, materials cut; tabulations for cutting steel and cast-iron with tools of carbon steel, high-speed steel, J metal and cemented carbide; calculations of cutting speeds and economic tool life, chip pressure, driving horsepower; how to make metal-cutting tests.

Leather Belting

SHORT-CENTER LEATHER-BELT DRIVES (1939). *Published by American Leather Belting Association, 100 Gold St, New York, N. Y. 68 pages, 8½x11 in., illustrated, tables, paper binding. Available on request.*

This book discusses the advantages of short-center flat-belt drives for electric motors and internal-combustion engines mounted on pivoted bases to maintain automatically correct tension in the belt. Results are given of tests to determine comparative operating efficiency of different kinds of belt drives. Cost of complete drives are compared.

Twenty-five pages, mostly tables, are devoted to the problems of how to select the drive you want, for motor sizes of 1 to 150 hp.

Thermodynamics

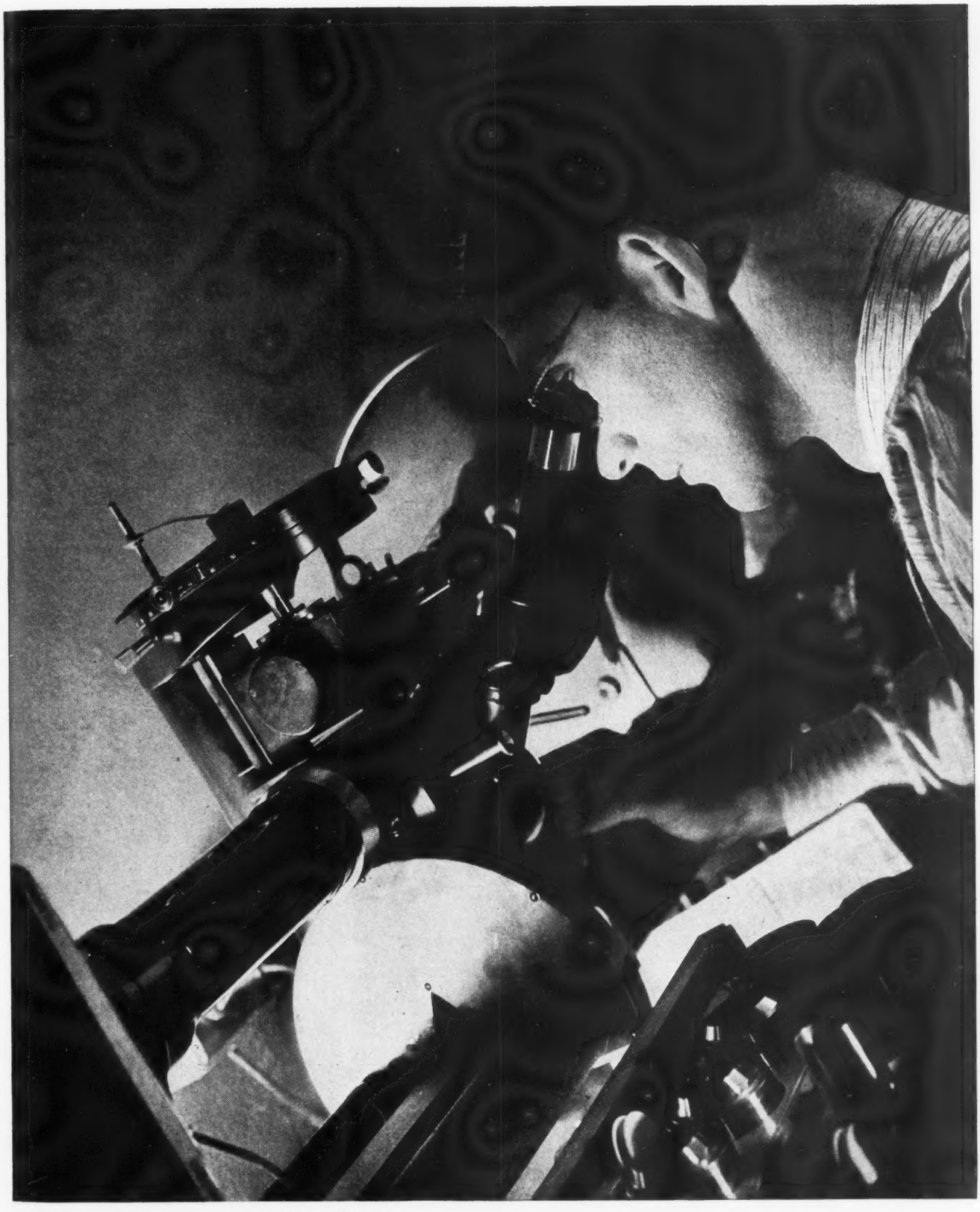
THERMODYNAMICS FOR CHEMICAL ENGINEERS (1939). *By Harold C Weber, Associate Professor of Chemical Engineering, Massachusetts Institute of Technology. Published by John Wiley & Sons, Inc, 440 Fourth Ave, New York, N. Y. 264 pages, 6 x 9 in., cloth binding. Price $3.25.*

This college text looks at thermodynamics from the chemical engineer's viewpoint as a subject much more broad than the simple expansion of steam in an engine. Mathematical approach to the subject restricts this book to classroom or advanced student use. For the latter, however, the author condenses much new material and new methods of approach to thermodynamic problems.

Mechanics

PROBLEMS IN MECHANICS (1939). *By G B Karelitz, Professor of Mechanical Engineering, Columbia University; J Ormondroyd, Professor of Engineering Mechanics. University of Michigan; and J M Garrelts, Associate Professor of Civil Engineering, Columbia University. Published by the Macmillan Co, 60 Fifth Ave, New York, N. Y. 271 pages, 6 x 9 in., illustrated by diagrams and sketches. Price, $2.50.*

Examples of practically every type of engineering problem in statics, kinematics and dynamics are arranged systematically with concise outline of the pertinent theorems and many worked-out solutions. Useful to any engineer wanting a thorough review of fundamentals of mechanics. The latter is one of the tools of the engineer best learned by proceeding from simple problems with worked-out solutions to the more difficult ones that occur in practice.

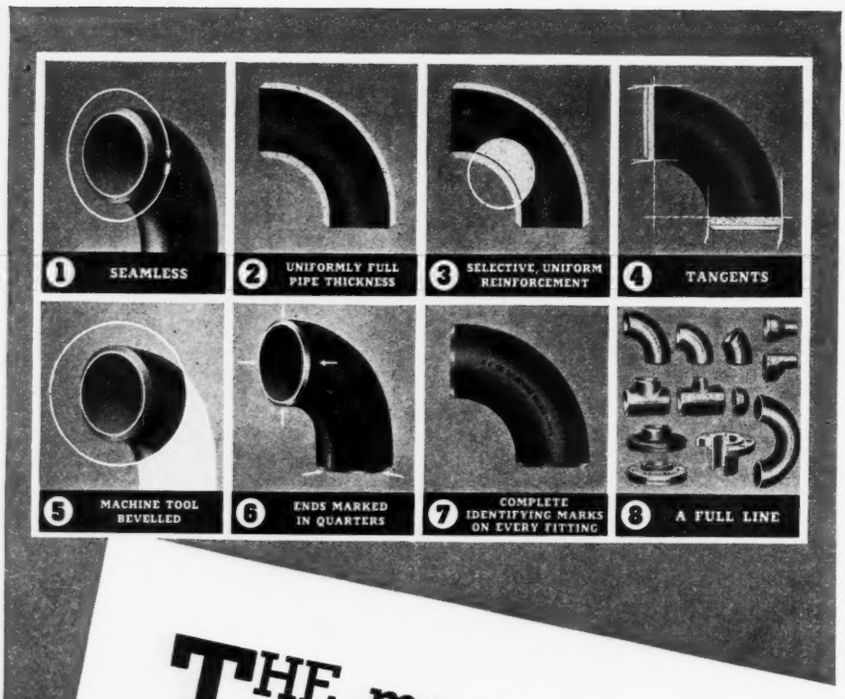


GRAIN STRUCTURE PROBLEMS. This Chase metallurgist is checking the grain structure of condenser tubes with a powerful microscope. But checking tube failures, and lengthening the life of the tubes, is not so easy. Yet Chase research engineers have been helpful on some tough cases. Can they help you? Just write.

CHASE BRASS & COPPER CO., *Incorporated*
Subsidiary of Kennecott Copper Corporation
WATERBURY CONNECTICUT

CHASE

CHASE CONDENSER TUBES


1 SEAMLESS
2 UNIFORMLY FULL PIPE THICKNESS
3 SELECTIVE, UNIFORM REINFORCEMENT
4 TANGENTS
5 MACHINE TOOL BEVELLED
6 ENDS MARKED IN QUARTERS
7 COMPLETE IDENTIFYING MARKS ON EVERY FITTING
8 A FULL LINE

THE man who said "welding fittings are just welding fittings" will please note these eight features that are combined only in Taylor Forge WeldELLS.

TAYLOR FORGE
WeldELLS
Seamless Pipe Fittings for Welding

TAYLOR FORGE & PIPE WORKS
General Offices and Works: Chicago, P. O. Box 485
New York Office: 50 Church Street

Power Lines

(*Continued from page* 128)

Presence of Process Lags," by C E Mason and G A Philbrick.

THERMODYNAMICS

"A Rational Representation of the Flow Performance of Reaction Steam-Turbine Blading," by Adolf Egli. "The Viscosity of Superheated Steam," by G A Hawkins, H L Solberg, and A A Potter. "Report on Change of Enthalpy of Steam With Pressure at Low Temperatures," by F G Keyes.

TURBINE BLADING

"An Investigation of the Energy Losses in Steam-Turbine Elements by Impact Traverse Static Tests With Air at Subacoustic Velocities," by W R New. "Photoelastic Analysis of Stresses in a Steam-Turbine Blade Root," by J J Ryan and J T Retaliata. "The Automatic Integrating Pressure-Traverse Recorder for Study of Flow Phenomena in Steam-Turbine Nozzles and Buckets," by H Kraft and T M Berry.

STEAM GENERATION

"Steam Boiler Performance and a Method of Comparison," by E G Bailey. "The Locomotive Boiler," by C A Brandt.

Boiler Construction Nears 1937 Level

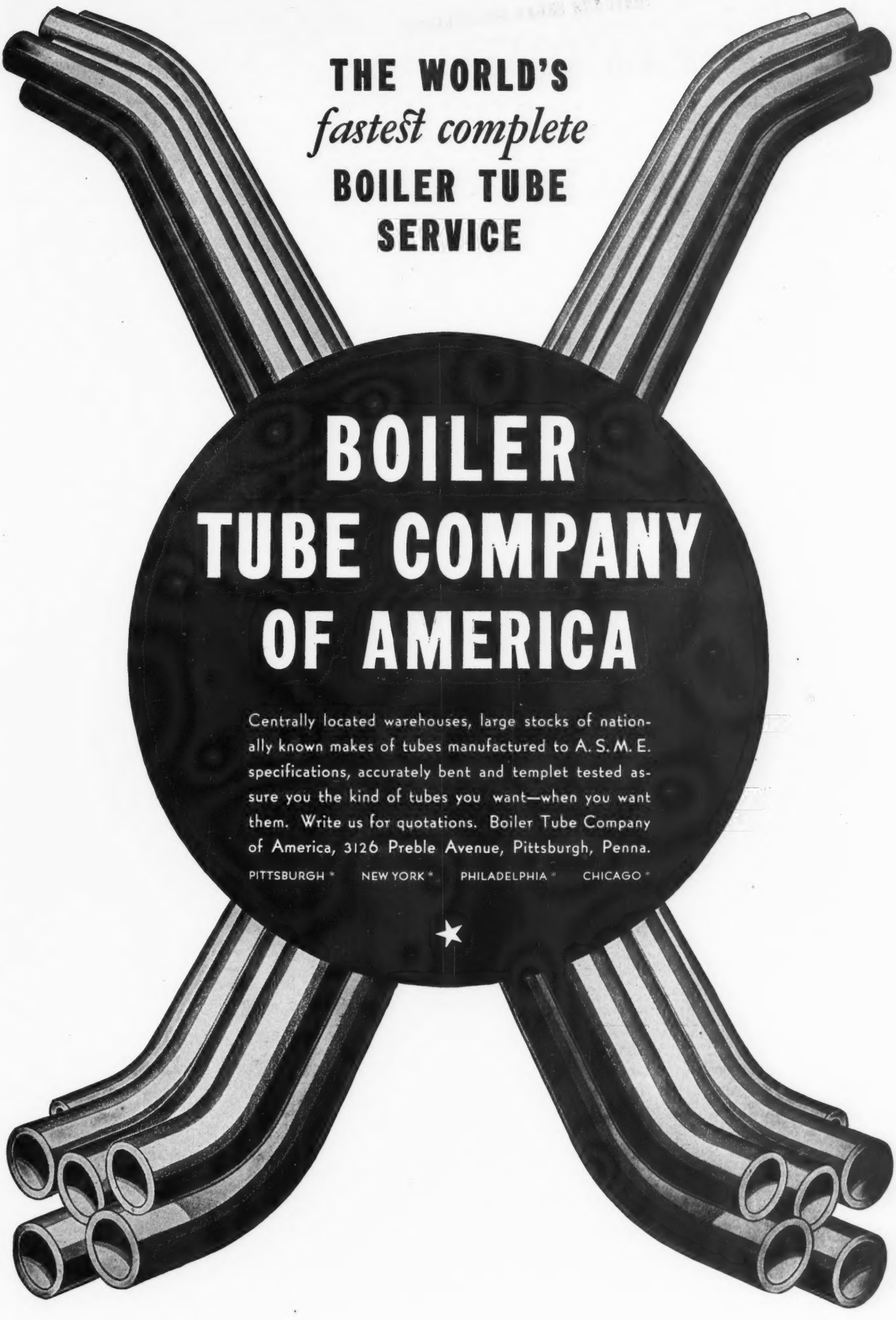
Present construction activity in the central-station field, plus several new projects announced but for which contracts have not yet been let, promises to exceed the boom period of 1937. One important difference is that the 1937 activity concerned mostly topping installations, whereas a major part of today's activity is with new plants.

For instance, it is understood that of more than 8,000,000 lb of high-pressure central-station steam-generating capacity now being built by one boiler manufacturer, Combustion Engineering Co, more than half is represented by units that will supply condensing turbines. Furthermore, less than a third will operate at 1400-lb pressure and the rest at 700 to 900 lb.

Among the 1400-lb installations are two 615,000-lb-per-hr units for Waterside Station, New York, three 425,000-lb-per-hr boilers for Northwest Station, Chicago, two of 285,000-lb-per-hr capacity for Westport Station, Baltimore, and one of 375,000 lb for Commerce St Station, Milwaukee.

To mention a few of the 900-lb units, there are four 400,000-lb-per-hr units for two stations of the Duke Power Co; one of similar size and type for the Mobile plant of Alabama Power Co and another for Macon Station of Georgia Power Co. The 525,000-lb unit being installed at Buzzards Point Station, Washington, D. C., is designed for 775 lb, as are also the two 250,000-lb units on order for Dresser Station, Terre Haute, Ind.

Of the installations mentioned, total steam temperatures range, with one exception, from 850 to 935 F.



THE WORLD'S
fastest complete
BOILER TUBE
SERVICE

BOILER
TUBE COMPANY
OF AMERICA

Centrally located warehouses, large stocks of nationally known makes of tubes manufactured to A. S. M. E. specifications, accurately bent and templet tested assure you the kind of tubes you want—when you want them. Write us for quotations. Boiler Tube Company of America, 3126 Preble Avenue, Pittsburgh, Penna.

PITTSBURGH * NEW YORK * PHILADELPHIA * CHICAGO *

From DAIRYING in MARYLAND to COAL MINING in INDIANA

Above: Green Spring Dairy, Baltimore, Md. 24 Johnson room thermostats control the temperature in the offices and public spaces, for comfort, efficiency, and economy.

At left: Talleydale Mine, Snow Hill Coal Company, Terre Haute, Ind. Johnson Record-O-Stat records and controls the temperature in the mine, to prevent crumbling of walls and roofs. To the right of the instrument, is the starter box for the air washer circulating pumps controlled by the Record-O-Stat and gauges showing the operation of each pump.

It's a far cry from dairying to coal mining! But the contrast between the two types of activity illustrates the wide application of *Johnson* automatic temperature and humidity control in solving the problems which arise in all kinds of industries. In many cases, such control is important for the actual work of protecting life and property, to say nothing of the comfort and efficiency of workers. In the processing of products, too, correct conditions, automatically maintained, are essential . . . Solving special problems is the regular order of business for Johnson engineers. They have intimate knowledge of many manufacturing processes. For the control of space heating and air conditioning, also, Johnson apparatus is used in the plant and office sections of many industrial establishments.

Call a Johnson Engineer. There is No Obligation.

JOHNSON SERVICE COMPANY

MILWAUKEE, WIS., AND DIRECT BRANCH OFFICES IN PRINCIPAL CITIES

PERSONALS

RALPH S MACPHERRAN, chief chemist of Allis-Chalmers Mfg Co for many years and identified with the iron and steel industry for nearly 50 years, has retired from active service. Harold J Stein, research engineer of the Manufacturing Dept, has been appointed director of Research, Chemistry and Metallurgy, bringing all these activities under one head. His assistant will be J T Jarman.

R O WATSON has been made sales manager of the Transportation and Generator Div of Westinghouse Electric & Mfg Co. Born in Duquesne in 1896, Mr Watson has been with Westinghouse since 1911, and since 1937 has been manager of the motor section of the Generator Sales Dept.

VICTOR H WALLACE has been appointed western sales manager of the Caterpillar Tractor Co, with headquarters at San Leandro, Calif., to succeed the late H H Chambers.

C S PATTON has been made sales manager of the Alco Products Div of American Locomotive Co. Mr Patton was graduated from Cornell in 1918, and has been manager of equipment sales for the past few years.

JOHN HENRY MCGUIRK of Buffalo has been appointed electrical engineer of a new power plant being built for the State Training School for Girls at Hudson, N. Y. Mr McGuirk was formerly chief electrical engineer at Auburn Prison and was previously employed at the Erie County Penitentiary and Buffalo State Hospital.

GEORGE ABBOTT, who has been superintendent of power and steam in the Berlin, N. H., plants of the Brown Co, pulp and paper concern, has also been named power superintendent of the firm's LaTuque plant, as well company personnel director.

MARTIN R KLITTEN of the McCarty Co, Los Angeles advertising agency, has been elected president of the Southern California chapter of the National Industrial Advertisers' Association.

C W RUTH has been appointed director of advertising of Republic Steel Corp, taking the place of Stanley A Knisely, who has become executive vice-president of Associated Business Papers.

OBITUARIES

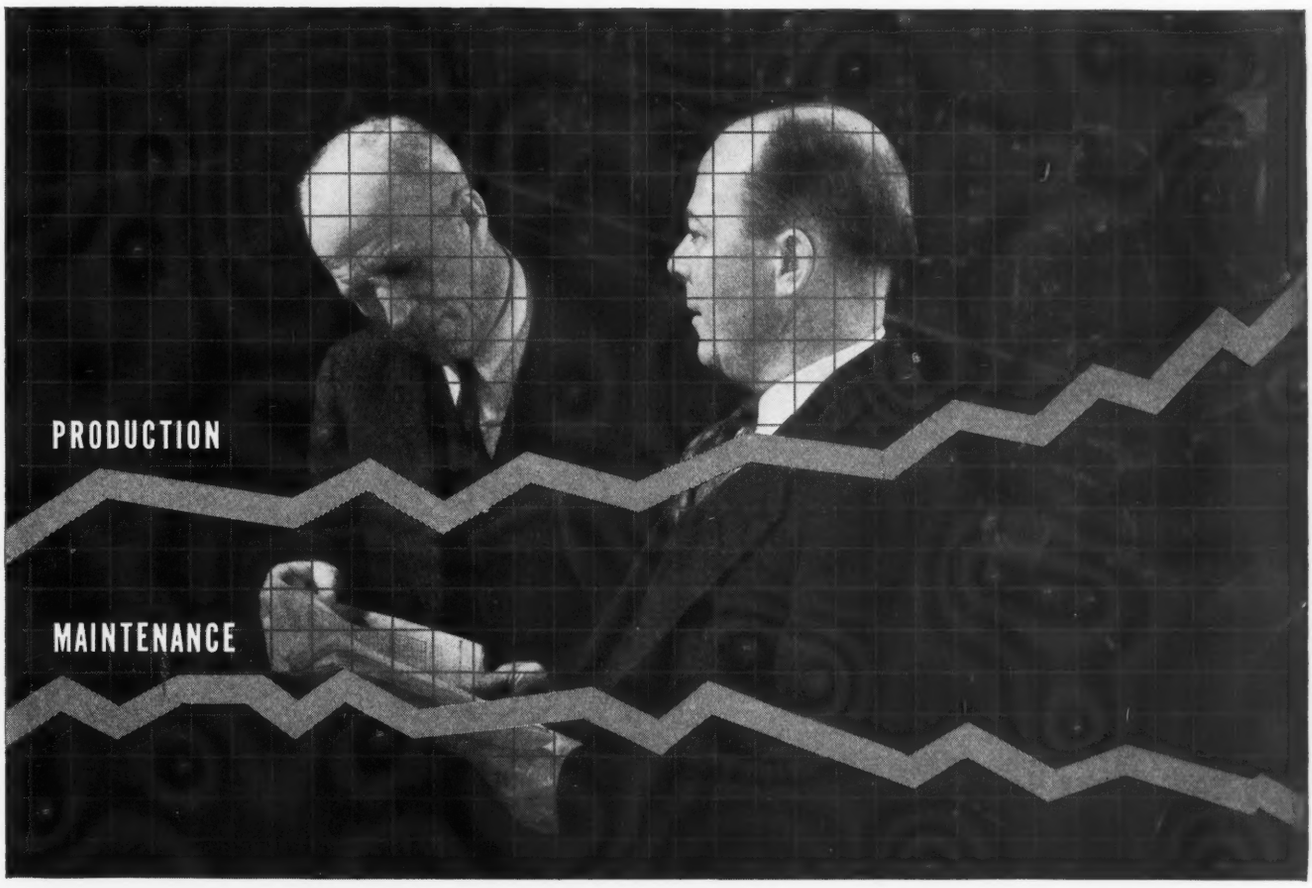
GERALD D MUNDELEIN, 64, city boiler inspector of Belleville, Ill., died at his home October 18 after nine weeks illness. Mr. Mundelein had been president of Local 13, Steam and Operating Engineers, for 45 years, city boiler inspector for 15 years, inspector of public schools for 40 years, and had served as switchboard operator for the Illinois-Iowa Power Co for 37 years.

J CLIFFORD THAYER, 72, for the past 25 years chief engineer of Thompson's Spa, Boston, Mass., died recently at his home in Braintree, Mass. Mr Thayer was the first apprentice of the old Fore River Ship and Engine Co, which was later absorbed by

"WE'VE PEPPED UP PRODUCTION

since we adopted

GULF'S HIGHER QUALITY OILS!..



. . . and still keep the maintenance-cost curve on the decline,"

. . . SAY LEADING PLANT OPERATORS.

"WE'RE being rewarded for the sound lubrication policy we adopted last year," says this operating official. "Now with production stepped up, we're having no mechanical difficulties and are enjoying still lower costs for maintenance. It has paid us to put the Gulf engineer's recommendations into practice."

Without further delay, you can put into operation in your plant a modern lubrication procedure that will insure you against the hazards of mechanical difficulties and losses which often accompany increased production schedules.

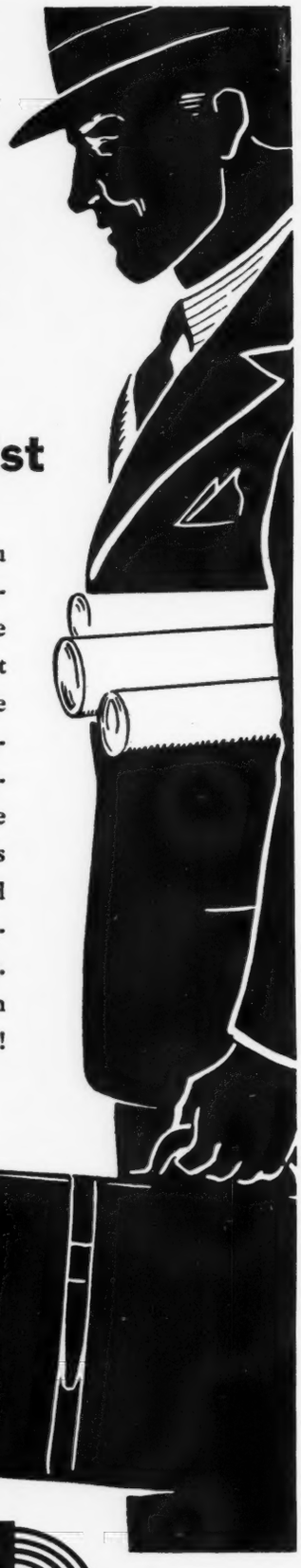
Ask the Gulf engineer who calls on you to work with your operating men toward the attainment of more efficient lubrication for all your equipment. His recommendations are based on sound knowledge and broad experience in the lubrication of equipment similar to yours. Gulf Oil Corporation, Gulf Refining Company, Pittsburgh, Pa.

GULF INDUSTRIAL LUBRICATION

To Maintain Quality . . .

. . . GULF RESEARCH MEN continually test lubricants with a wide variety of specially designed equipment. Oils and greases are subjected to a wider range of operating conditions than are encountered in actual service. Thus Gulf's engineers are able to recommend lubricants which not only meet the prevailing conditions, but provide an *extra margin of safety!*

THIS MAN CAN HELP YOU



He's a Water Treatment Specialist

"THE SCAIFE MAN" is a good man for you to meet and know at any time—but particularly when you have a really bothersome boiler feed water problem to discuss. Let him shoulder your difficulty! His acute knowledge of proven techniques in handling power plant water has been demonstrated in successful cooperation with the largest as well as the smallest plants . . . his readiness to serve you is immediate . . . and back of him are the full resources of a long-established leader in water conditioning.

A consultation does not obligate you in any way. Call in The Scaife Man today!

SCAIFE

MANUFACTURES FOR THE POWER INDUSTRY:

Water Softeners: Hot Lime Soda . . . Cold Lime Soda . . . Sodium Zeolite . . . Hydrogen Zeolite. **Water Filters:** Gravity . . . Pressure. **Continuous Blowdowns; Zeolite Minerals; Filter Refills.**

Let us quote you!

FOUNDED SCAIFE 1802

WM. B. SCAIFE & SONS CO.

General Office, Laboratory and Works—OAKMONT, PA.

(Pittsburgh District)

Representatives in Principal Cities

the Bethlehem Corp, and was in charge of many trial trips of vessels built at the Fore River yard. After service in the World War, he joined up with Charles Eaton, founder of Thompson's Spa.

REGINALD F RICHARD, 55, general manager of the Phospate Div, Monsanto Chemical Co, died October 25 at Barnes Hospital, St. Louis. Mr Richard was associated with General Chemical Co from 1905 to 1933 in various positions connected with plant operations, being general manager at the time of his leaving to join Swann Chemical Co, which was acquired by Monsanto in 1935.

A EUGENE MICHEL, 59, owner of the technical advertising firm of A Eugene Michel & Staff, New York, N. Y., died at his home in Douglaston, N. Y., November 10, of heart disease. Mr. Michel, a native of St. Louis, Mo., was graduated from Rose Polytechnic Institute in 1903, and before organizing his own agency six years later, worked for several technical concerns. From 1903 to 1905, he was designing engineer with Diamond Chain Mfg Co, Indianapolis. Next year, Mr Michel was with Ewart Mfg Co, and in 1906 he came to New York as assistant manager of publicity for International Steam Pump Co. In 1907 he was assistant manager of publicity for Johns-Manville and in 1908 manager of George H Gibson Co.

Readers' Problems

(*Continued from page* 107)

sure will increase the ammonia flow into the cooler, it does not always produce the desired result. The lower pressure may have a tendency to flash into gas such ammonia as passes through the expansion valve. The lower the pressure, the drier the gas would tend to be. Dry gas has a lower heat transfer rate than if the inside of the cooler is splashed with liquid.

The solution to the problem is usually larger expansion valves or rearrangement of the piping system. Very often hand expansion valves can be drilled out to pass more liquid. An examination of the valve should indicate whether this is feasible.

As to the power savings from a lower head pressure, MC should read the excellent article in the July, 1938, issue of POWER, by W H Martin and R E Summers of Oregon State College, on this subject. It might be possible, in the absence of a wattmeter on the switchboard, to determine the power requirements of the refrigerating plant by counting the revolutions of the power company's meter. This can be done for a minute with equipment operating under low head pressure and for another minute at high head pressure. This must

LARGE OR SMALL

- The inherent properties for prolonging valve life are built into every Powell Valve — regardless of size.
- To Powell, the satisfactory operation of the 1/8" needle valve for closely regulating the flow of liquids or gases is equally important as the trouble-free performance of a large size high-pressure, high-temperature steam valve.
- Large or small—every Powell Valve means lower maintenance costs and smoother operation.

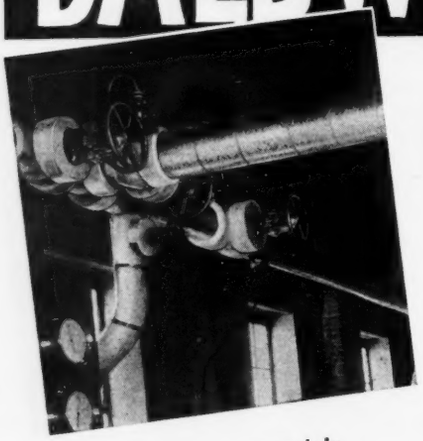
Specify

Write for the Powell Catalogs. Free on request.

POWELL VALVES

THE WM. POWELL CO. CINCINNATI, OHIO

BALDWIN-HILL



ROCKWOOL PIPE COVERING

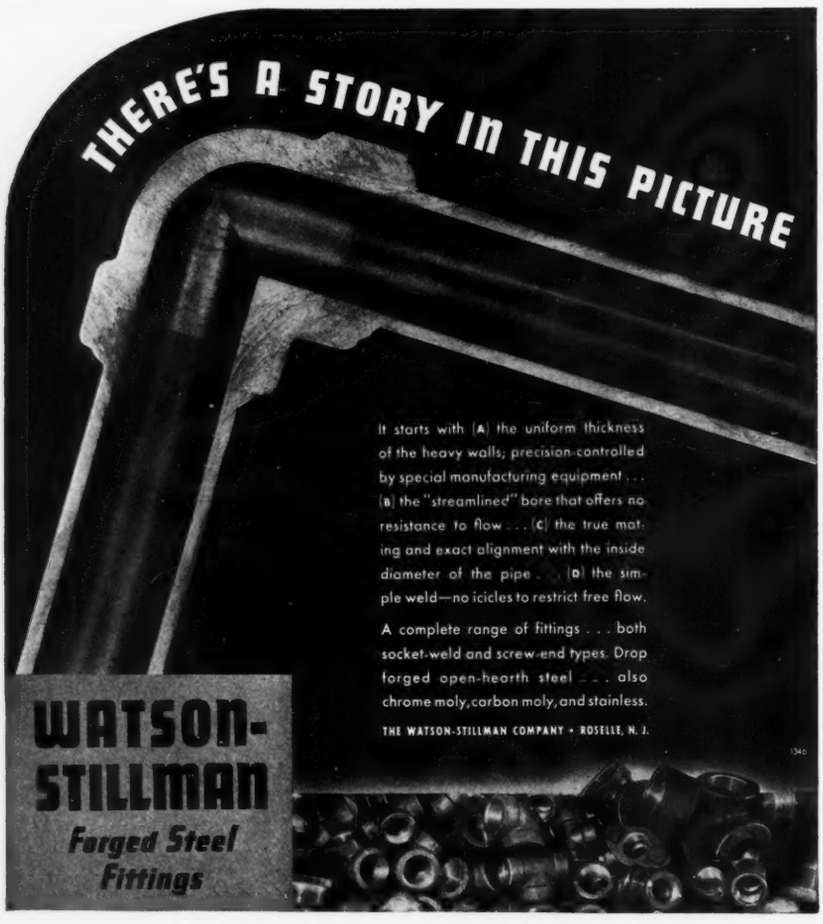
Cuts Heat Losses of Large Utility

Because of its efficiency proved in laboratory tests and in actual use, B-H Rockwool Insulation was selected for its extraordinary ability to cut heat loss and fuel costs. Shown is a 6 in. steam line insulated with 2½" Pipe Covering, covered with 28 gauge galv.iron banded with galv.iron straps.

BALDWIN-HILL CO.
575 Klagg Ave.
TRENTON, N. J.

BALDWIN-HILL B-H INSULATIONS

Write for Catalog Showing Complete Line


THERE'S A STORY IN THIS PICTURE
It starts with (A) the uniform thickness of the heavy walls; precision-controlled by special manufacturing equipment . . . (B) the "streamlined" bore that offers no resistance to flow . . . (C) the true mating and exact alignment with the inside diameter of the pipe . . . (D) the simple weld—no icicles to restrict free flow.
A complete range of fittings . . . both socket-weld and screw-end types. Drop forged open-hearth steel . . . also chrome moly, carbon moly, and stainless.
THE WATSON-STILLMAN COMPANY • ROSELLE, N. J.
WATSON-STILLMAN
Forged Steel Fittings

be done with constant suction pressure and load.

East Haven, Conn. E F SIBLEY

Something Wrong

UNLESS THERE IS A POWER PENALTY for low power factor caused by underloaded induction motors which may be erased by a slight increase in load, MC should certainly reduce the condensing pressure to the minimum possible without increasing cost. However, the reduced freezing time of 135 lb over 90 lb is proof that something is wrong with the relationship between head pressure and freezing time within the system.

Of the important variables governing freezing time, three are entirely within the evaporators. These are quantity of liquid, boiling point and rate of flow. Since rate of flow becomes constant in steady operation, it can be ignored. The boiling point is governed by suction pressure, which in turn depends on the compressor speed or displacement.

This leaves the quantity of liquid as the only variable over which the head pressure has some degree of control. MC's trouble with the lower pressure shows that there is a lack of liquid furnished to the evaporators, a lack that can be explained by one or more of the following factors:

1. Undercharged system.
2. Feed line too small.
3. Clogged scale traps—mesh of strainer too fine or corroded.
4. Impurities in liquid.
5. High pour-point oil congealing at expansion valves.
6. Line obstructed by excess litharge mix at screw connection.
7. High-viscosity oil lying in coils beyond expansion valves.
8. Obstructed equalizer line not holding liquid in condensers, while a mixture of gas and liquid is fed to coils. Receiver gage should show this.
9. Lead disk of feed-line stop valve has come out of socket and stuck to the seat eccentrically, obstructing flow where valve closes with pressure.
10. Oil trapped in strainers may permit free flow of liquid at the 20-F higher temperature of the liquid at 135 lb over 90 lb, assuming no subcooling.

Marissa, Ill. GEORGE BLUM

STRAWS

Pointing the way business winds blow

ALABAMA —— Central Alabama Cold Storage & Locker Corp, Selma, plans new 1-story cold storage and refrigerating plant with locker system.

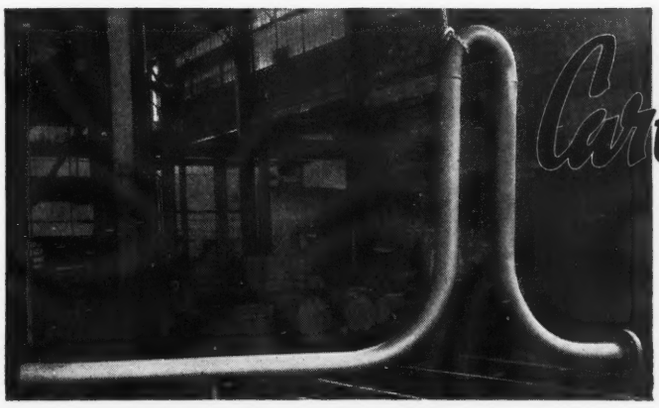
Farmers' Meat Processing Co, Selma, plans new cold-storage and refrigerating plant, with locker system of about 100 units. Cost close to $35,000.

CALIFORNIA —— Burbank contracted

PITTSBURGH PIPING CAN MEET
Your Piping Requirements to the Letter

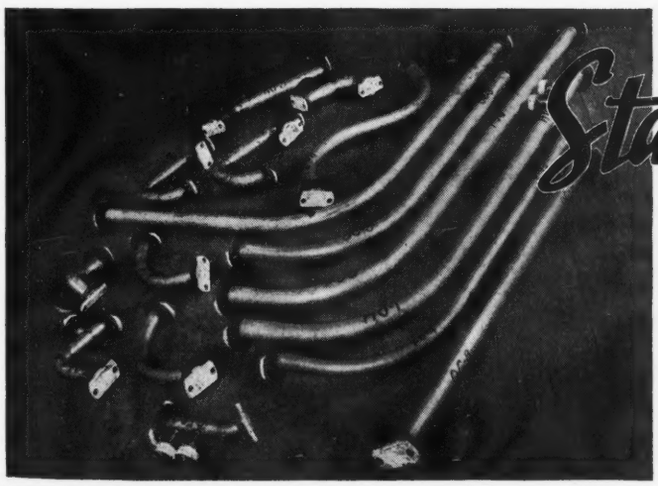
Carbon Moly Steel Piping

Since the increase in steam pressures and temperatures made the use of low alloy steels necessary, Pittsburgh Piping has fabricated and erected this type of piping for many of the country's foremost power systems. Because Carbon Molybdenum and other low alloy steels require extra care in fabrication, Pittsburgh Piping has developed a special technique for the highly efficient working of this type of material. This special technique extends to all operations in field erection as well.



Carbon Steel Piping

In its five acre plant, Pittsburgh Piping has complete facilities for pre-fabricating large sub-assemblies for every conceivable power and process requirement. Modern erection equipment and field welding methods used by specially trained crews assure speedy and efficient erection without interfering with other sub-contractors on the job.



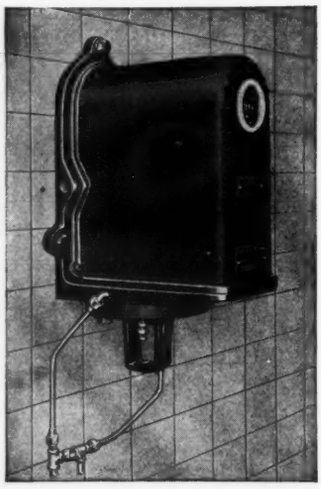
Stainless Steel Piping

Since 1933, the Alloy Division of Pittsburgh Piping has been fabricating stainless piping and vessels for process industries. Because of the many metallurgical characteristics peculiar to stainless steel alone, Pittsburgh Piping has experienced fabricators that work only on stainless. The relative high cost of raw materials makes it more imperative than ever to have this type of fabrication done by stainless specialists at Pittsburgh Piping.

PITTSBURGH PIPING & EQUIPMENT CO., 10 FORTY-THIRD ST., PITTSBURGH, PA.

Woolworth Bldg. New York | Occidental Bldg. Indianapolis | Peoples Gas Bldg. Chicago | General Motors Bldg. Detroit | Public Sq. Bldg. Cleveland | 10 High St. Boston | 1st. Nat'l. Bank Bldg. Charlotte | 525 Market St. San Francisco

Pittsburgh Piping



SIMPLEX

puts a toy to . . . . work

For years the Gyroscope, with its complex and peculiar force actions, has presented an intriguing study to the engineer and scientist . . . Once used only as a toy or for personal transportation via the bicycle, in late years its principle has been adapted to new and useful services . . . Simplex is proud to offer for the first time in the industrial field an instrument employing gyroscopic action—The

• SIMPLEX • GYROMETER

an accurate and sensitive meter for totalizing the flow of any fluid . . . Built for a wide range of capacities and very reasonably priced.

Write today for technical data

SIMPLEX

VALVE & METER CO.

6780 Upland St.

PHILADELPHIA, PA.

Allis-Chalmers Mfg Co, Milwaukee, Wis., at $253,400 for 10,000-kw turbine-generator and accessories for installation in new steam-electric municipal power plant. Also has low bid from Riley Stoker Co, Worcester, Mass., at $155,729 for boiler unit and auxiliary equipment with rated capacity of 120,000 lbs per hr, and will make award soon. Contracts for miscellaneous equipment will be made at early date. Complete station will cost about $800,000. H I Stites, city manager.

Glendale has low bid at $42,860 from Loomis Co, for steam condenser for municipal power plant, and will make award soon.

Douglas Aircraft Corp, 3000 Ocean Park Blvd, Santa Monica, plans 1-story addition, 200 x 250 ft, to airplane-manufacturing plant, and will begin superstructure soon. Cost over $150,000 with machinery and power equipment. Edward C and Ellis W Taylor, 803 West Third St, Los Angeles, architect and engineer, respectively.

State Dept of Public Works, Division of Architecture, Sacramento, plans early call for bids for power plant at Southern California State Prison, Chino; also for service piping, tunnels, etc. Work will be carried out in connection with erection of other buildings at institution. Fund of $1,100,000 is being arranged for entire project.

COLORADO——Montrose is considering municipal power plant. Estimates of cost are being made.

Bd of Directors, State Home and Training School, Ridge, plans 1-story boiler plant at institution, 45 x 53 ft, with installation of boilers and auxiliary equipment. C Francis Pillsbury, Midland Savings Bldg, Denver, architect.

Bureau of Reclamation, Denver; contracted S Morgan Smith Co, York, Pa, at $749,000 for three 40,000-hp hydraulic turbines for installation in new hydroelectric power plant at Parker Dam, Parker Dam Project, Ariz.-Calif. Also made award to Woodward Governor Co, Rockford, Iowa, for three governors with pumping equipment for turbine units noted, at $56,040 (Specifications 867).

CONNECTICUT——Hanson-Whitney Machine Co, 139 Bartholomew Ave, Hartford, plans 4-story addition to machine works, 60 x 80 ft. Also will build addition to boiler house, with installation of new boiler unit and auxiliary equipment. Cost over $80,000. John T Henderson, 750 Main St, architect and engineer.

FLORIDA——Homestead plans improvements in municipal power plant and waterworks station, including installation of 600-hp diesel-generator unit and auxiliary equipment. Work will begin soon. Fund of $75,000 has been secured through Federal aid.

GEORGIA——Whitley Construction Co, Lagrange, plans 1-story cold-storage and refrigerating plant in connection with new frozen food products factory on local site. Cost about $60,000.

IDAHO——Bd of Regents, University of Idaho, Moscow, will award contract soon for addition to boiler plant at institution, including installation of new boiler units and auxiliary equipment. Cost about $90,000. Lincoln Bouillon, Fourth Ave Bldg, Seattle, Wash., consulting engineer.

Northern Idaho Rural Electrification Rehabilitation Association, Sandpoint, plans hydroelectric power plant at outlet of Priest Lake, including power dam, generating station and transmission line for power supply for rural electric system. Cost about $196,000, of which $150,000 will be used for station project. Financing has been arranged through Federal aid.

ILLINOIS——Altamont has awarded contracts for diesel engine and generator, exciter and auxiliaries to Fairbanks, Morse & Co, at $26,600. W A Fuller Co, 2916 Shenandoah Ave, St. Louis, Mo., consulting engineers.

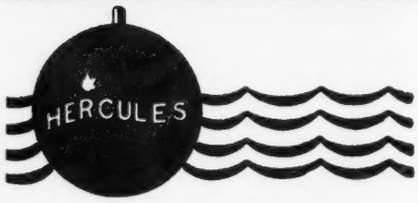
Sears, Roebuck & Co, West Arthington and South Homan Sts, Chicago, plans complete air-conditioning system in new 3-story and basement retail store building, 138 x 150 ft, at Adams and Second Sts, Phoenix, Ariz. Cost about $250,000. Work scheduled to begin early in 1940. Company engineering department, first noted address, in charge.

Franklin Park Frozen Foods, Inc, Franklin Park, recently organized, care of Worthman & Hallman, 5736 North Richmond Ave, Chicago, architects, plans boiler house at new plant at Belmont and Washington Sts, Franklin Park, where property has been acquired, including building to be remodeled and improved. Also will install cold-storage and refrigerating department and pre-cooler rooms. Cost about $150,000.

HERCULES

Seamless Copper

FLOATS



GUARANTEED TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process, Hercules Floats are uniform in thickness and high in mechanical strength.

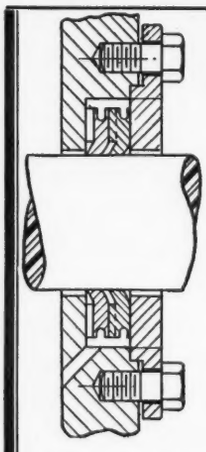
You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS

200 Franklin St.

SPRINGFIELD, MASS.



SAVES OIL

France Oil Return wiper rings are made to conform to the design of the splash plate. Users report a considerable saving in oil from this type of installation.

Accurate and prompt service for complete sets or renewals for any type of existing splash plates. Write for catalog of commonly used types.

THE FRANCE PACKING CO.

Tacony, Phila., Penna.

Branch offices in principal cities

Original

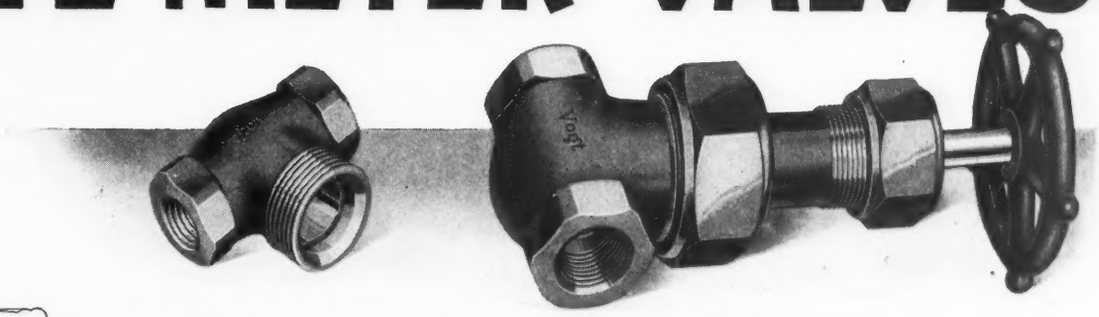
FRANCE

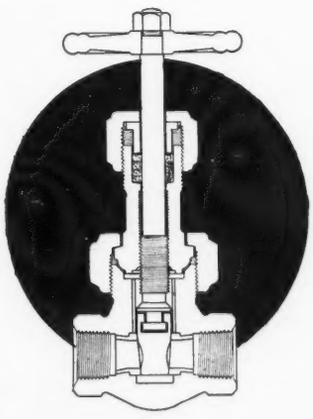
METAL PACKING

Look! THEY'RE New

Vogt DROP FORGED STEEL

GATE METER VALVES





"These new Vogt Drop Forged Steel Gate Meter Valves are strong and tough and they prove they can "take it," by giving continuous, drop-tight service in meter and gage lines at high pressures and high temperatures."

"Seats are rolled-in and easily removable; the gate is of the loose, slotted type and a ground joint is between the body and bonnet. You can get them in 1/4" 3/8" 1/2" 3/4" and 1" sizes with stainless steel trim or all-stainless steel to suit operating conditions."

"SUPPLEMENTARY PAGE 39-C GIVES FURTHER DETAILS—WRITE FOR IT!"

HENRY VOGT MACHINE CO., Inc., LOUISVILLE, KY.

NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS

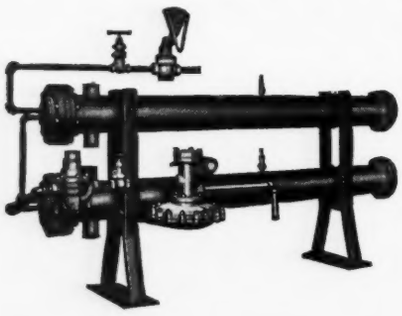
HENSZEY CONTINUOUS BLOWDOWN SYSTEMS

have solved the above problems for others. And it can do it for you!

Write today for the complete story of how this system continuously and automatically draws off the trouble-making boiler water impurities at a rate that keeps the boiler water concentration at a predetermined proper degree. All this can be accomplished *without the heat loss* of ordinary intermittent blowdown.

HENSZEY COMPANY

Dept. *D 12* • Watertown, Wis.



HENSZEY

BOILER WATER CONCENTRATION CONTROL SYSTEMS

INDIANA——Brooklyn plans installation of two 300-gpm motordriven deepwell pumping units, with gas-engine standby equipment, in connection with improvements in municipal water system. Contracts will be awarded soon. Harry O Garman, Indiana Pythian Bldg, Indianapolis, consulting engineer.

Logansport will award contract soon high-pressure piping and other miscellaneous equipment at municipal power plant, where improvements are under way. Charles Ammerman, Century Bldg, Indianapolis, consulting engineer.

IOWA —— Greenfield recently awarded contract for a 700-hp diesel generating unit, exciter, etc, to Fulton Iron Works, St. Louis, Mo., at $42,777. Stanley Engrg Co, Muscatine, consulting engineers.

Hubbard Ice & Fuel Co, 1124 First St, N W, Cedar Rapids, plans 1-story cold-storage and refrigerating plant on adjoining site. Cost about $35,000 with equipment.

Sioux City plans installation of new boilers in municipal steam plant, to replace present old units. Estimates of cost are being made. Contract will be placed soon.

Brooklyn has engaged Stanley Engrg Co, Muscatine, consulting engineer, to prepare plans for new municipal power plant, for which a bond issue of $135,000 recently was authorized. Proposed to use diesel-generators and accessory equipment.

Dept of Indian Affairs, Washington, D. C., plans steam power house at sanatorium at Tama. Cost about $25,000, with boiler and auxiliary equipment.

Plymouth Processing Co, Fort Dodge, plans rebuilding of soy bean processing mill recently destroyed by fire. A new boiler house will be built. Cost over $175,000 with machinery and power equipment.

Fort Dodge will award contract soon for new 600-hp. vertical-type hydraulic turbine for installation in municipal hydroelectric generating plant, to be used with an electric generator unit previously purchased.

Cedar Rapids is considering new municipal hydroelectric power plant on site near end of State St. Clark N Streeter, city engineer.

KANSAS——Standard Rendering Co, 635 Adams St, Kansas City, plans two additions to grease and tallow works, 1- and multi-story type. Will also build new boiler house. Cost close to $100,000. M H Doyne, Railway Exchange Bldg, St. Louis, Mo., consulting engineer.

State Bd of Regents, State House, Topeka, contracted Murray Iron Works, Burlington, Iowa, for one 5,000-lb. boiler and auxiliary equipment for installation in power house at Kansas State College, Manhattan.

LOUISIANA —— Commercial National Bank, Shreveport, plans central-heating plant in new 17-story office building at Texas and Edwards Sts. Cost about $1,000,000. Samuel G Weiner, Ardis Bldg, Shreveport, architect; McKim, Mead & White, 101 Park Ave, New York, N. Y., consulting architects.

Morgan City contracted Fairbanks, Morse & Co, at $71,500 for 1,050-hp diesels for installation in municipal power plant. Joseph Evans, city engineer, in charge.

Delta Hardwood Lumber Co, Trout, plans boiler plant in connection with rebuilding of portion of lumber and planing mill recently destroyed by fire. Loss about $150,000.

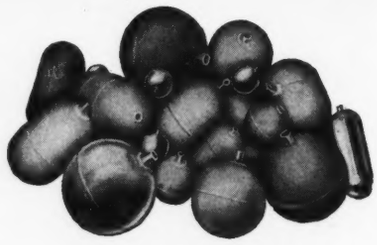
MARYLAND——Consolidated Gas, Electric Light & Power Co, Baltimore, contracted General Electric Co, Schenectady, N. Y., for new 67,000-hp turbine-generator unit and auxiliary equipment for installation at steam-electric power plant at Westport. Award will be made soon for high-pressure boilers and auxiliary equipment. Construction now in progress, to be completed next summer, will cost about $3,600,000 and will add approximately $4,500,000 to that amount, with completion scheduled in summer of 1941.

Bd of Managers, Springfield State Hospital, Sykesville, will award contract soon for boiler unit and auxiliary equipment for power house at institution, where improvements will be made. Henry P Hopkins, 10 East Mulberry St, Baltimore, architect.

MASSACHUSETTS——Monsanto Chemical Co, Chemical Lane, Everett, plans 2-story and basement addition to plant. Cost close to $60,000 with machinery and power equipment.

MICHIGAN——Pent-Hex Corp, Muskegon, affiliated with West Michigan Consumers Co, same place, plans new gasoline absorption plant in vicinity of Grand

NICHOLSON



HIGH-PRESSURE WELDED FLOATS

Available for all applications—for steam pressures up to 1500 lbs. and hydrostatic pressures up to 2500 lbs.—for corrosive and non-corrosive service.

Made in spherical and elliptical shapes and in sizes from 2½" to 14" diameter. High in tensile strength and offer great resistance to external pressure. Special sizes and shapes available to order, and also cadmium, nickel or copper plated. Fully described in Bulletin No. 339.

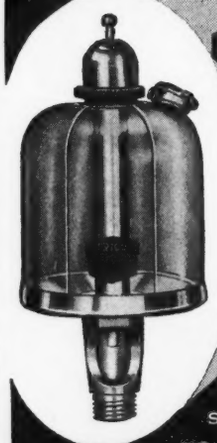
OTHER PRODUCTS — NICHOLSON Industrial Steam Traps, Piston and Weight Operated Traps, Flexible Couplings, Expanding Mandrels, Arbor Presses, Compression Shaft Couplings, Steam Eliminators and Separators, Compressed Air Traps.

W. H. NICHOLSON & COMPANY
WILKES-BARRE PENNSYLVANIA, U.S.A.

New!!

TRICO

UNBREAKABLE GRAVITY FEED OILERS



ULTRA-MODERN
UNBREAKABLE
STREAM-LINED
NO GASKETS TO LEAK
50% LESS WEIGHT
REINFORCED DUAL RATCHET FEED ADJUSTMENT

AMERICA'S FINEST GRAVITY FEED OILER. MODERNIZED AND STREAMLINED TO HARMONIZE WITH ADVANCED IDEAS OF MACHINE DESIGN. 12 DISTINCTIVE FEATURES—METAL PARTS CADMIUM-PLATED FOR BEAUTY AND EASY-CLEANING. 3 STYLES IN ONE, TWO, FOUR AND EIGHT OZ. CAPACITIES.

WRITE FOR BULLETIN No 26

TRICO FUSE MFG. CO., Milwaukee, Wis.
In Canada: IRVING SMITH LIMITED, Montreal

BOILER PLANT MODERNIZATION

that Pays for Itself!

SPRINGFIELD has a long and enviable record of successful installations—the result of close cooperation with engineers in charge of boiler plant modernization programs. Much of the success can be credited to the flexibility of the Springfield design and to our ability to give real personal attention to each job.

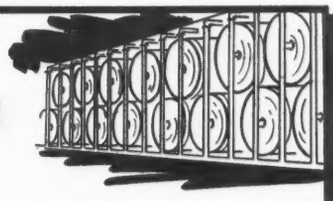
Because of our independent position, we can give you a complete unit incorporating auxiliary equipment selected on an unbiased basis as most suitable for your particular conditions.

If you are now contemplating boiler plant modernization, give yourself the benefit of "checking with Springfield." No obligation—call or write.

SPRINGFIELD BOILER COMPANY
Springfield, Illinois
CHICAGO • PHILADELPHIA • DALLAS • OSWEGO
CINCINNATI • BATON ROUGE • NEW YORK • BOSTON
DETROIT • PITTSBURGH • MINNEAPOLIS • MEXICO CITY

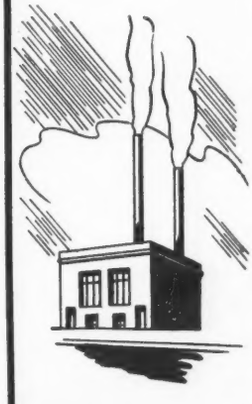
PACKER GETS 24% ANNUAL RETURN

$35,324.00 saved in the first 165 days was the startling record in a prominent mid-western packing plant after modernizing with a complete Springfield generating unit. Opportunities similar to this have been found in numerous processing plants.



$20,000.00 A YEAR FOR PAPER MILL

COST REDUCTIONS totaling $20,000.00 in the first year is a typical Springfield record in a Michigan paper manufacturing plant. This was achieved despite a 15% production increase.



34½% CUT IN STATION HEAT RATE

MODERNIZATION of power stations continues to be one of the most active fields for cost reducing programs. In a recent Springfield installation in Missouri, the total cut in station heat rate amounted to 34½% and many desirable modern operating features were secured.

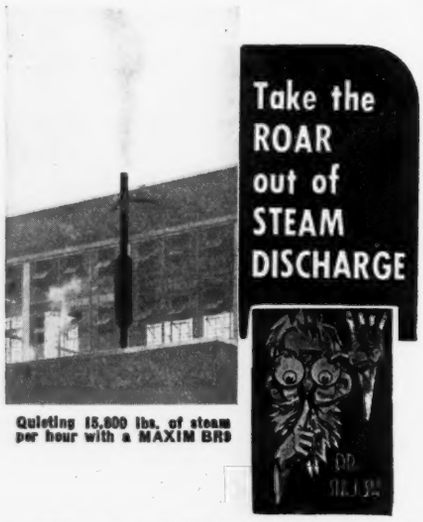
SPRINGFIELD

STEAM GENERATING UNITS

SPRINGFIELD BOILERS

ANY SIZE ANY FUEL ANY PRESSURE

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide
KEEP YOUR MEN OFF LADDERS—
control valves from the floor
With Babbitt Sprocket Rims on your overhead valves, you can control valves instantly from the floor. Far quicker and safer than climbing ladders.
Babbitt Rims are easily attached in a few minutes, are inexpensive and assure safe, positive and instantaneous overhead valve operation. Available for valves of every make or style. Write for details.
BABBITT STEAM SPECIALTY CO.
New Bedford Mass.



WITH the new MAXIM SILENCER, MODEL BR9, our engineers have developed an efficient, practical, easily installed means of taking the noise out of high velocity steam, air or gas discharges—an ideal method of quieting the roar from safety valve and relief valve discharges.

Call on Maxim engineers to handle your problem of noise elimination. Investigate TODAY.

THE MAXIM SILENCER COMPANY
HARTFORD, CONN.
NEW YORK, N. Y.

Rapids, where site has been acquired, to include a compressor station, pumping plant and other mechanical units. Cost about $100,000.

Holland contracted Johnson Larsen & Co, 6530 Baubien St, Detroit, for power house piping and auxiliary equipment for municipal power station now in course of erection, at $123,800. Hamilton & Weeber, Federal Sq Bldg, Grand Rapids, and Giffels & Vallet, Inc, Marquette Bldg, Detroit, consulting engineers.

Grayling, contracted W G Winright, Marshall, for construction of new municipal power plant. Award for diesel-generator unit and accessory equipment will be made separately. Ayres, Lewis, Norris & May, Ann Arbor, consulting engineers.

MINNESOTA——Twin City Milk Co, Anoka, approved plans for 1-story boiler house, 60x70 ft., at local milk products plant, to include installation of a 4500-lb. boiler and accessory equipment.

Vernon Center Creamery Association, Vernon Center, is considering 1-story cold-storage and refrigerating plant with locker system. Estimates of cost are being made.

MISSOURI——Jefferson City. The State Building Commission, c/o the Bi-Partisan Advisory Bd, Edgar M Eagan, executive secretary, Merchants Bank Bldg. has awarded contracts as follows: Furnishing and installing chimney and broeching work at the power plant of the Missouri State Penitentiary, Jefferson City, to Alphons Custodis Chimney Co, 140 South Dearborn St, Chicago, Ill., at $9,000, and contract for resetting boilers, stokers and auxiliaries for said power plant to Eichler Heating Co, 2125 Locust St, St. Louis, Mo., at $79,000. Furnishing and installing electrical work at the power plant for auxiliary prison near here to J H Mackay Electric Co, 2610 Olive St, St. Louis, Mo., $12,000, and for diesel driven generating unit and auxiliaries for auxiliary prison to Chicago Pneumatic Tool Co, 1931 Washington Ave, St. Louis, Mo., at $37,000. All awards are subject to final approval by the PWA.

State Bldg Dept, Capitol Bldg, Jefferson City, will award contract soon for 1000-kw generator unit and auxiliary equipment for installation in Capitol Bldg, power station.

NEBRASKA——Nebraska Hydro Electric Power Co, Inc, Spencer, recently organized by Harold E Wood and Frank J. McArthur, Spencer, plans hydroelectric power plant in vicinity of Spencer, including transmission and distributing system.

NEW JERSEY——Lionel Corp, 28 Saeger Pl, Irvington, has filed plans for 1-story addition to electrical and mechanical toy-manufacturing plant, 200x400 ft. Cost about $100,000 with machinery and power equipment. Daniel J. Scrocco, 210 Tremont St, Orange, architect.

Wright Aeronautical Corp, 132 Beckwith Ave, Paterson, plans 1-story addition to airplane engine-manufacturing works, totaling about 300,000 sq ft of floor space, and will begin work soon. Cost close to $1,000,000 with machinery and power equipment.

NEW YORK——Central New York Power Corp, Syracuse, affiliated with Niagara-Hudson Power Corp, Buffalo, contracted General Electric Co, Schenectady, for 80,000-kw turbine-generator unit with accessories, for installation in generating station now in course of construction at Oswego, making second unit of this rating to be installed in plant; award for first generator was made to same company a number of months ago. Contract also has been let to Babcock & Wilcox Co, New York, for high-pressure boilers and auxiliary equipment, duplicating initial installation. Cost of initial plant, scheduled for completion next spring, will approximate $9,500,000, and second unit, to be completed in fall of 1941, will cost about $7,000,000.

NORTH CAROLINA——Laurence S Barringer Hotels, Columbia, care of Dial & Thomas, Columbia, architects, plan central-heating plant in new 12-story hotel on North Tryon St, Charlotte. Cost close to $1,000,000.

Duke Power Co, Charlotte, contracted Combustion Engrg Co, New York, N. Y., for boiler units and auxiliaries for new 80,000-kw power plant at Dukeville, near Salisbury, on which work will begin soon. Cost close to $7,000,000. Completion is scheduled in June 1941.

Carter Fabrics Corp, South Elm St, Greensboro, plans new 1-story rayon weaving mill at South Boston, Va. A power house will be built. Cost over $750,000 with machinery and power equipment. J E Sirrine & Co, Greenville, S. C., consulting engineers.

North Carolina Pulp Co, Plymouth, approved plans for five 1-story additions to local sulphate pulp mill. Cost over $250,000 with machinery and power equipment. Work will proceed at once.

OHIO——Procurement Division, U. S. Air Corps, Wright Field, Dayton, contracted York Ice Machinery Corp, York, Pa., at $189,294 for installation of a refrigeration system at local field (Circular 40-69).

Bd of Trustees, Miami University, Oxford, has plans maturing for alterations and improvements in power plant at institution, to include new radial brick stack, pumping machinery and accessories, and other equipment. Cost about $30,000. Fosdick & Hilmer, Union Trust Bldg, Cincinnati, consulting engineers.

Sabina plans improvements in municipal power plant, including installation of new equipment. Cost about $42,000. Bond issue in that amount is being arranged.

Amherst has plans maturing for municipal power plant and will place award for equipment in near future. Cost about $145,000. Floyd G Browne, Marion, consulting engineer.

Toledo will take bids soon for filtration plant and elevated steel tank and tower for municipal waterworks; filter machinery with daily capacity of 30,000,000 gals. will be installed. Cost close to $1,800,000. William Clark, acting chief waterworks engineer, in charge. George N Schoonmaker, city manager.

Cleveland Electric Illuminating Co, Cleveland, plans new generating station on Lake Front Rd and Seventieth St, N E, with installation to include turbine-generators and accessories with capacity of 60,000-kw, high-pressure boilers and auxiliary equipment. Contracts for equipment will be made soon. Completion is scheduled early in 1941. Cost about $6,300,000.

Proctor & Gamble Co, Cincinnati, contracted Babcock & Wilcox Co, New York, N. Y., for integral furnace boiler unit of 200,000-lb per hr capacity, and auxiliary equipment, for installation in power house at local soap and edible oil plant at Ivorydale. Furnace will use pulverized coal as fuel. Award for improvements in station building has been let to H K Ferguson Co, Hanna Bldg, Cleveland, Ohio.

OKLAHOMA —— Continental Oil Co, Ponca City, has authorized new 8-in. welded-steel pipeline from San Diego, Tex., oil field district (Duval County), to connection with main line at Corpus Christi, Tex., about 26 mi, for crude oil transmission. It will replace an existing 5½-in. pipeline, recently purchased from Crude Oil Pipe Line Co.

PENNSYLVANIA —— Carnegie - Illinois Steel Corp, Carnegie Bldg, Pittsburgh, will award contracts soon for 32,000-kw turbine-generator, and for boilers, stokers, pumps and accessory equipment for new power plant at Carrie blast furnaces, Rankin, to be used for power supply for this and other steel mills in Monongahela Valley district. Stone & Webster Engrg Corp, Union Trust Bldg, Pittsburgh, and 49 Federal St, Boston, Mass., consulting engineer.

Resinous Products & Chemical Co, 222 West Washington Sq, Philadelphia, plans 4-story plant at Richmond and Kennedy Sts. Cost close to $100,000 with machinery and power equipment.

Pennsylvania Power & Light Co, Allentown, plans improvements in steam-electric power plant on Cedar St, Harrisburg, with installation of new 10,000-kw turbine-generator and accessories, two high-pressure boilers with rating of 185,000 lbs per hr, and auxiliary equipment. Bids are scheduled to be asked soon. Cost about $3,000,000.

Wilson & Co, 420 South Second St, Harrisburg, meat packers, have leased a 1-story building, 50x120 ft, at 1101-43 Berryhill St, and will remodel and equip for new cold-storage and refrigerating plant. Cost over $50,000. Main offices are at Union Stock Yards, Chicago, Ill.

Armstrong Cork Co, Lancaster, has approved plans for improvements in boiler house at plant at Railroad and Twenty-third Sts, Pittsburgh, with installation of additional equipment.

Philadelphia Toilet & Laundry Co, 1027 Vine St, Philadelphia, plans new boiler house at mechanical laundry, with installation of boiler unit and auxiliary equipment. Ballinger Co, 105 South Twelfth St, architect.

SOUTH CAROLINA——Aiken Electric Refrigerating Co-Operative, Inc, Aiken, Monson Morris, president, plans 1-story cold-storage and refrigerating plant. Cost about $25,000. Financing is being arranged through Federal aid.

THE ORIGINAL clip type valve with drain channels and bronze bonnet-thread-bushing . . . . . .

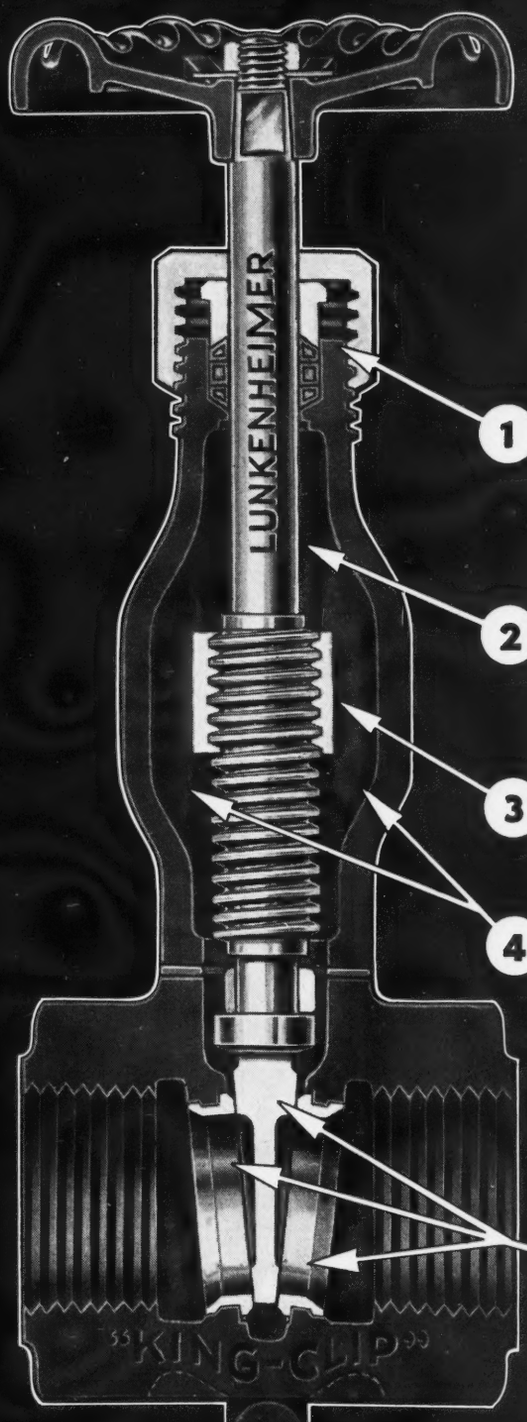


Fig. 1640

LUNKENHEIMER

Fig. 1640 "KING-CLIP"

(The King of Clip Valves)

1 Stuffing Box
Extra strong construction—hexagon head gland.

2 Bronze Stem
Perfectly aligned—repacking seat above stem threads.

3 Bronze Bonnet Bushing—
Cast in. Non-corrodible contact for stem.

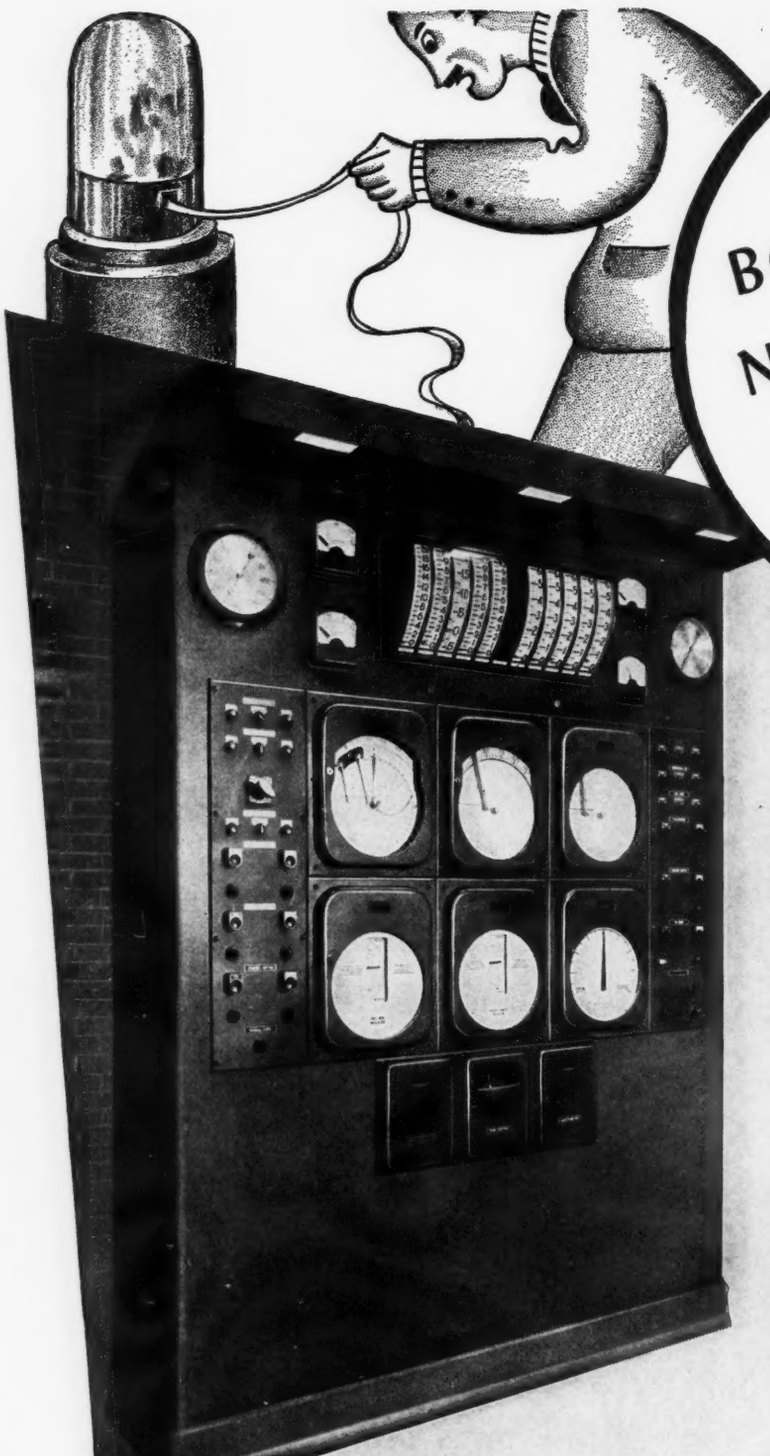
4 Drain Channels
Large and unobstructed—ample size to drain bonnet. Will not clog.

5 Bronze Disc and Rolled in Bronze Seat Rings
Bronze to bronze contacts prevent corrosion.

ESTABLISHED 1862
THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, OHIO, U. S. A.
NEW YORK CHICAGO
BOSTON PHILADELPHIA
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK

CARRIED IN STOCK BY LUNKENHEIMER DISTRIBUTORS

5-81-42



THIS BOILER ROOM NEWS TICKER Gives the Answer NOW!

YESTERDAY'S MARKET quotations are no good today. Similarly, facts about boiler and furnace conditions must be fresh—and accurate.

There is instant response between the necessity for correcting combustion conditions and the actual adjustment when Hays automatic combustion control is on the job. Also the results of the adjustment are electrically recorded so there is no time lost in getting the facts before the boiler room attendants.

Hays Automatic Combustion Control not only effects surprising economy in fuel but maintains the entire steam plant at the peak of efficiency. Steam pressure is maintained constant under wide variation in load.

There is a Hays engineer-representative near you to inspect your steam plant without obligation and advise on the cost and effectiveness of automatic combustion control. Much general information may also be freely obtained by writing 905 Eighth Avenue, Michigan City, Indiana.

Hays also makes draft gages CO_2 meters and portable combustion testing instruments.

The HAYS CORPORATION

SINCE 1901 COMBUSTION INSTRUMENTS AND CONTROL

MICHIGAN CITY, INDIANA, U.S.A

ANOTHER USER SAYS "THE EXTREME DUCTILITY OF J&L SEAMLESS BOILER TUBES MAKES THEM EASY TO INSTALL"

The Olson Water and Towing Company, New York City, operates a fleet of six steamers. Naturally their operations depend upon keeping these boats on the job. So when boiler repairs are necessary, they want the work completed quickly and economically. That's why this company uses J & L Seamless Steel Boiler Tubes.

Mr. John G. Olson, general manager, writes: "We have previously installed your tubes in several of our tow boats and have always found them to be entirely satisfactory in every respect. The boiler makers recommended J & L tubes very highly because of their extreme ductility which makes installation very easy.

J & L Seamless Boiler Tubes are safe and dependable. Their longer life and increased efficiency keep boilers on the job. Your J & L distributor has a complete line of J & L Seamless Tubes. He is listed in the Classified Telephone Directory under "Boiler Tubes." Call him for quick service. Write today for a copy of our Boiler Tube Bulletin.

J & L—PILOTS THE COURSE OF CONTROLLED QUALITY IN STEEL

JONES & LAUGHLIN STEEL CORPORATION

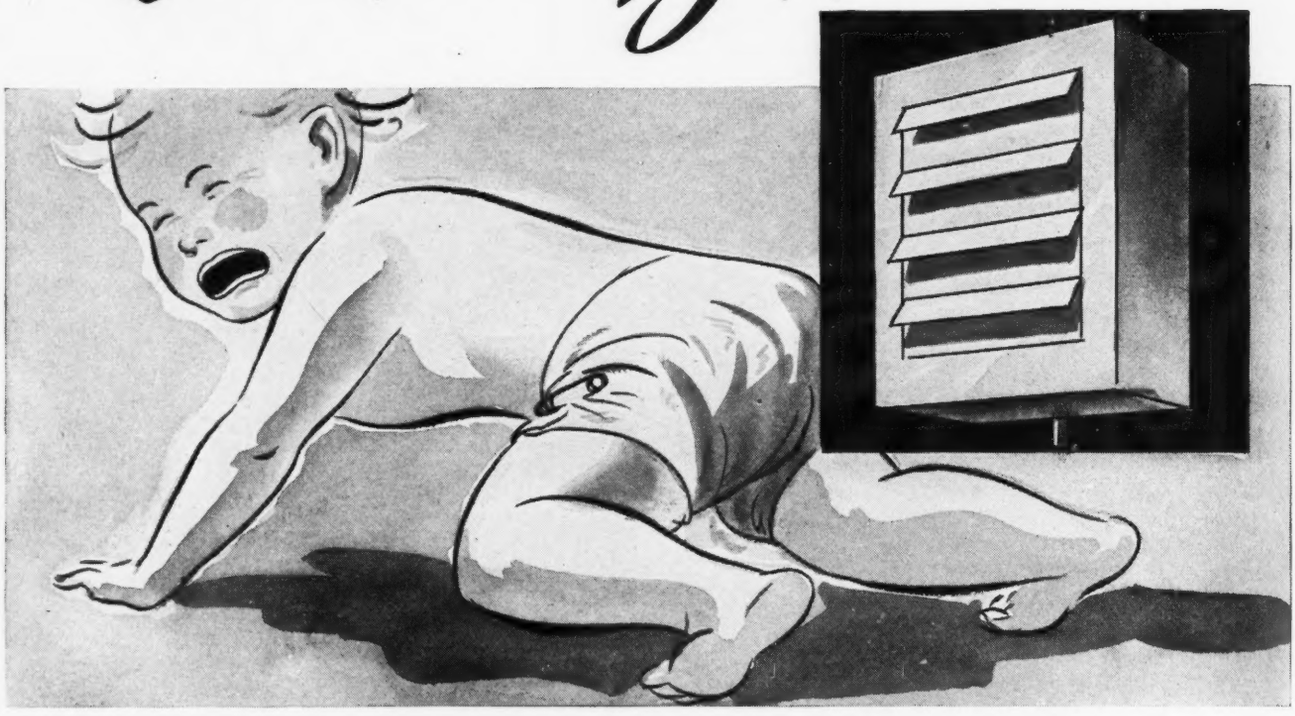
AMERICAN IRON AND STEEL WORKS

PITTSBURGH, PENNSYLVANIA

J&L STEEL

J & L—PARTNER IN PROGRESS TO AMERICAN INDUSTRY

A Cold Bottom



Means it's time to change

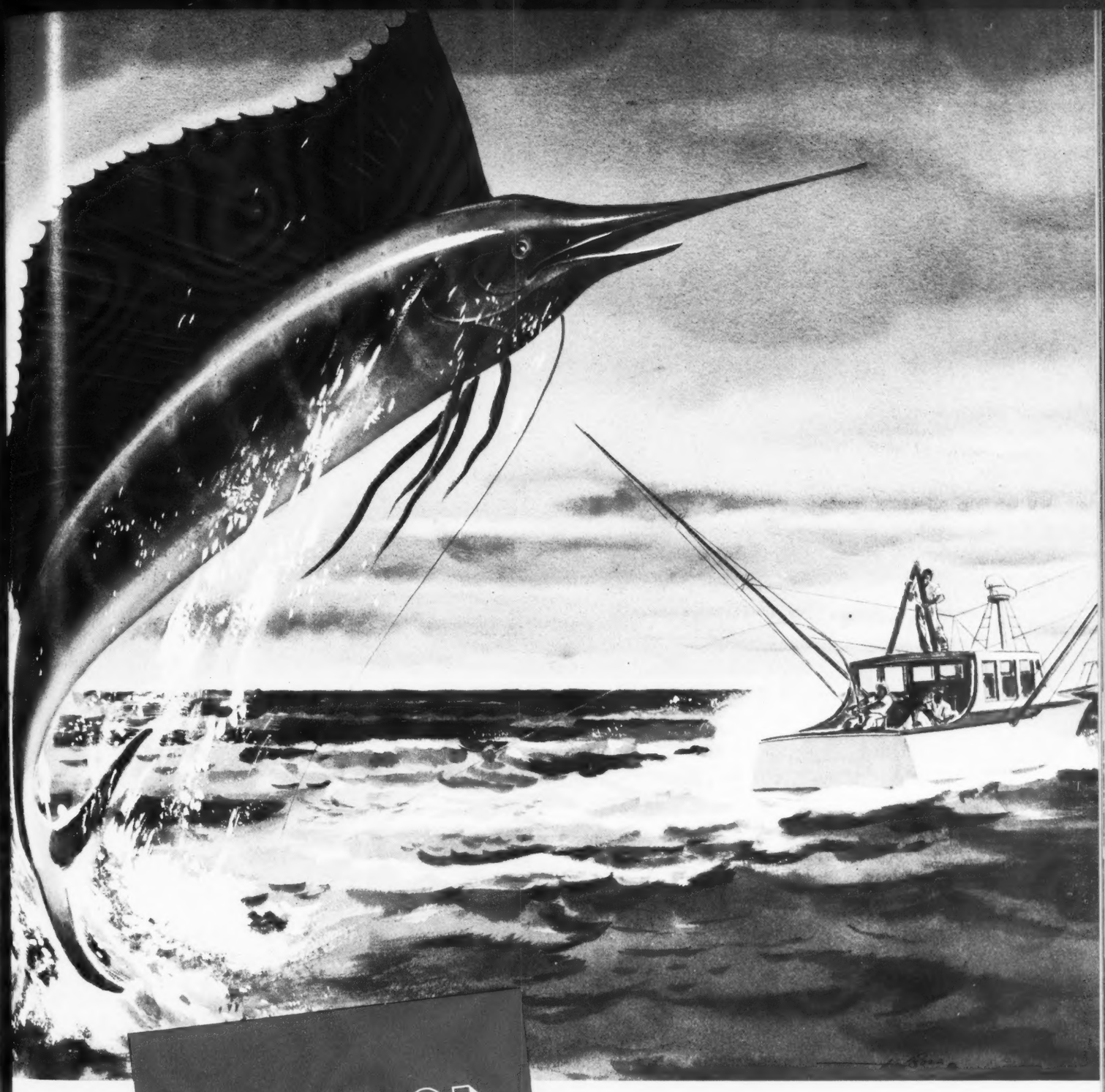
● A unit heater with a cold bottom is a unit heater that needs a change of steam traps – a change to Anderson Super-Silvertop. The change is needed because the old trap is not removing air and condensate from the system. That is why the unit is cold – it isn't full of hot, dry steam.

Anderson Super-Silvertop steam traps keep a unit heater bone dry and free of entrained air at all times. Over fifty years of steam trap manufacturing experience back the design of this engineered steam trap. It has guided bucket, straight-in-line and built-in elbow piping, ease of inspection and extra long service life.

Examine your unit heaters – remember that a cold bottom means it's time to change – to Anderson Super-Silvertop.

THE V. D. ANDERSON COMPANY
1934 WEST 96TH STREET • CLEVELAND, OHIO

Super-Silvertop STEAM TRAPS

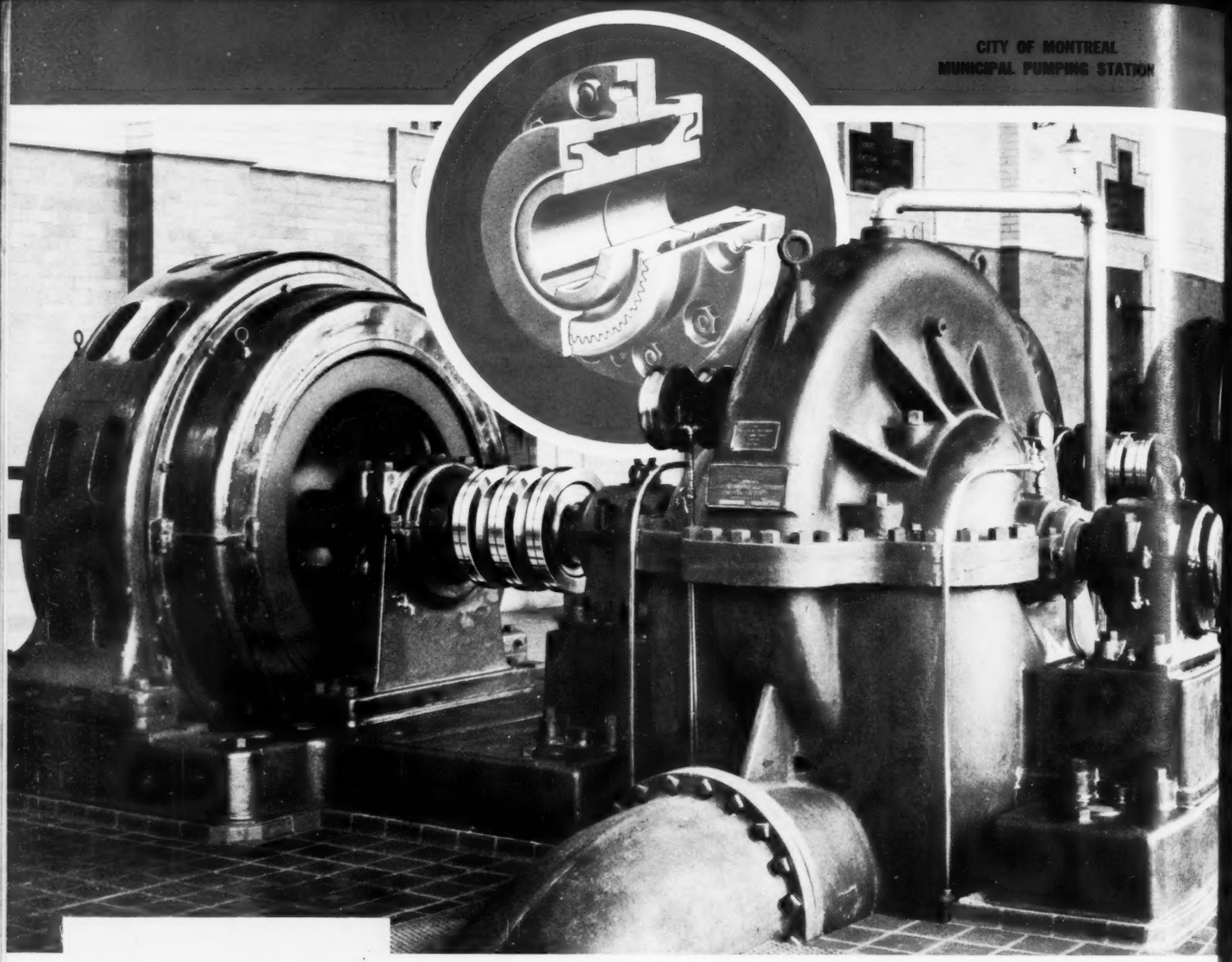


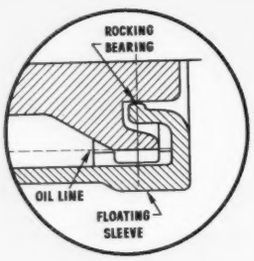
WHERE **CONTROL** IS WORTH EXTRA EFFORT

The high initial quality of Koppers Coal is reinforced by careful control of every step in mining, preparation and loading, and is maintained by dual inspection and thousands of laboratory check-tests yearly. The extra results obtained in boiler room efficiency and economy make this extra effort well worth while—as a trial order will prove. May we serve you? The Koppers Coal Company. Offices in Principal Cities.

KOPPERS COAL

CITY OF MONTREAL
MUNICIPAL PUMPING STATION





This detail drawing shows Fast's construction. The load carrying surfaces are protected against wear by a positive film of oil. This oil is kept permanently clean by the rocking bearings which make precise metal-to-metal contact and are in the one position where they form permanent dust and moisture-proof seals. No perishable materials are used. No attention but oiling is required.

THIS VETERAN COUPLING IS NOW IN ITS 19TH YEAR OF CONTINUOUS SERVICE

The coupling pictured above was installed on a 30,000,000 gallon pump at the Municipal Pumping Station, City of Montreal, in 1921. In 1926 this pump was replaced with a new one of the same capacity. The five year old coupling was re-installed on the new pump, and is still serving.

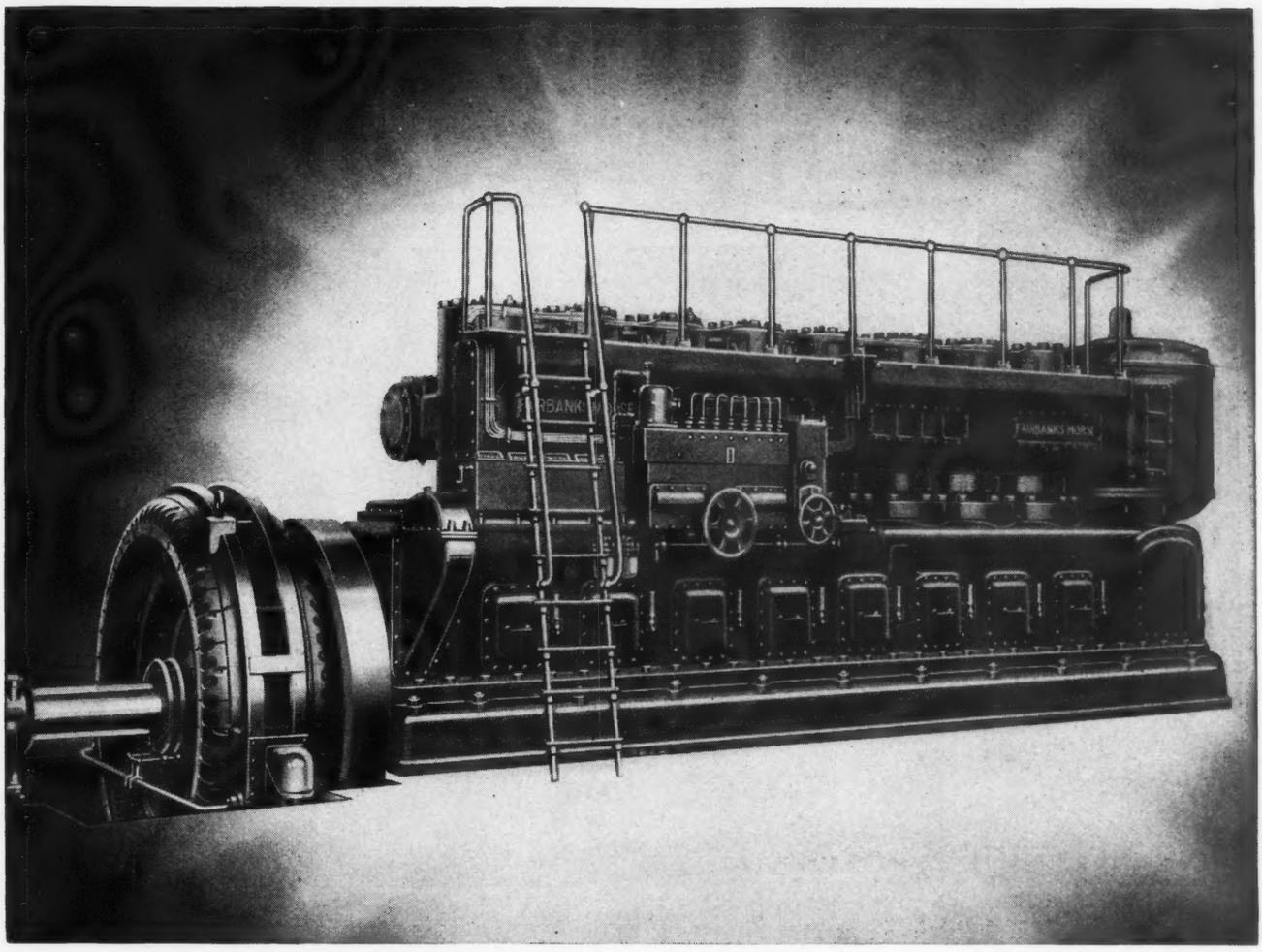
Dependability like this is the direct result of certain engineering and design features exclusive with Fast's. For trouble-free operation, specify *genuine* Fast's Couplings on the machinery you purchase.

KOPPERS COMPANY
BARTLETT HAYWARD DIVISION
BALTIMORE, MD.

OTHER KOPPERS PRODUCTS FOR THE POWER FIELD: Coal . . . Coke . . . American Hammered Piston Rings and Packing . . . Treated Poles, Cross-Arms and Timber . . . Waterproofing . . . Built-up Roofs . . . Material Handling Systems . . . Special Machinery.

FAST'S SELF-ALIGNING COUPLINGS

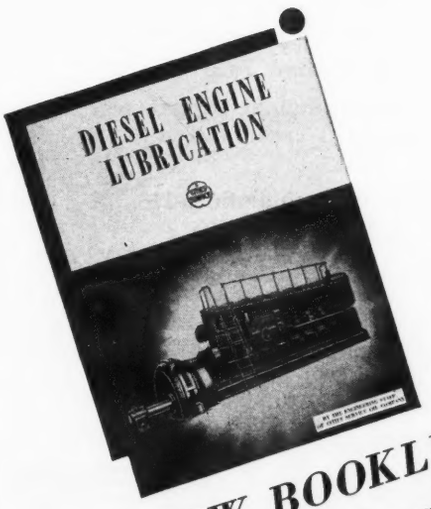
a KOPPERS product



PROVED BY YEARS OF SERVICE

Cities Service Diesel Lubricants are *Service Proved.* For years they have withstood gruelling tests in all types of industrial plants—and, as always, they have proved capable of giving outstanding service.

You are cordially invited to call on the Cities Service Lubrication Engineers to help you with your lubrication problems. Cities Service Lubrication Engineers have a wealth of experience in the Diesel lubrication field, and you are free to draw on their knowledge. There is no charge. We also shall be glad to mail you a copy of our new booklet, "Diesel Engine Lubrication." Just fill in and mail the attached coupon.



NEW BOOKLET FREE—just clip and mail

CITIES SERVICE OIL COMPANY
Sixty Wall Tower—Room 1626 P, New York

☐ Please send full details concerning your Lubrication Engineers' Service.

☐ Please send me a copy of your free booklet, "Diesel Engine Lubrication."

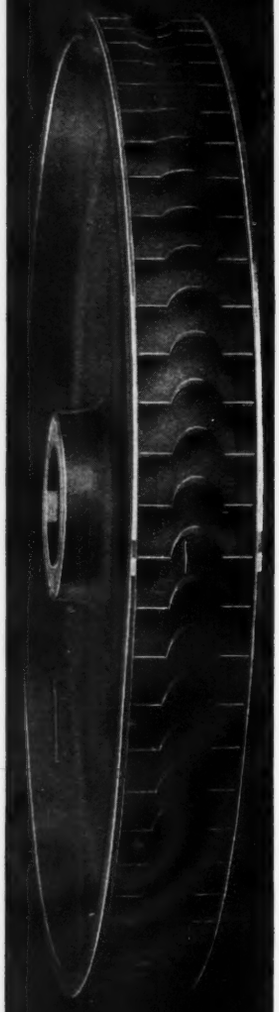
Name..... *Title*.....

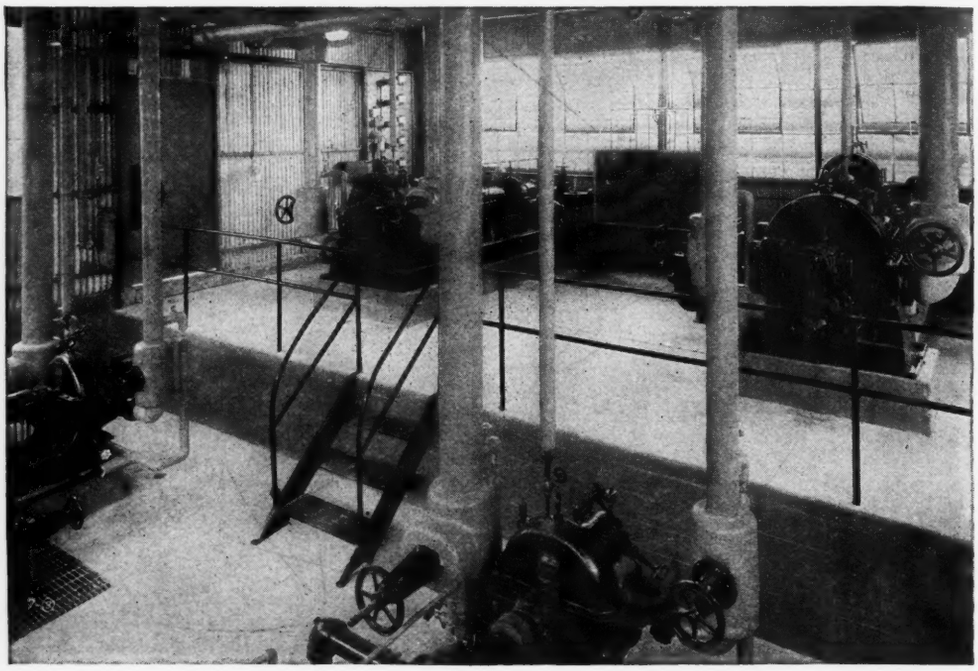
Firm Name.....

Business Address.....

City..... *State*.....

TERRY





GENEROUS BLADE CLEARANCES IN TERRY WHEEL TURBINES INCREASE DEPENDABILITY

The actual clearance between the moving and stationary blades in Terry Wheel Turbines is greater than ⅛ inch. End play cannot affect this clearance and the side clearance is one inch or more. It is therefore not essential for the operator to make frequent adjustments of the thrust to secure efficient and safe operation.

The Terry Wheel Turbine is fully described in our bulletin S-116. A request on your business letterhead will bring a copy.

* *Above*

Interior of a gasoline plant recently completed by Parkhill-Wade for Belridge Oil & Gas Co. of Belridge, Calif. Four of the twenty Terry Turbines used by Belridge are shown.

T-1131

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

Order from Your Nearest Distributor as Listed Below:

IN THE UNITED STATES

"RPM" DELO:
The California Company (Montana only)
Humble Oil & Refining Company
Standard Oil Company (Indiana)
Standard Oil Company (Nebraska)
Standard Oil Company of California
Standard Oil Company of Texas
Utah Oil Refining Company

Diol "RPM" DELO:
The Carter Oil Company, Tulsa, Oklahoma
Colonial Beacon Oil Company
Standard Oil Company of Louisiana
Standard Oil Company of New Jersey
Standard Oil Company of Pennsylvania

Kyso "RPM" DELO:
Standard Oil Company (Inc. in Kentucky)

Signal "RPM" DELO:
Signal Oil Company

Sohio "RPM" DELO:
The Standard Oil Company (Ohio)

IN CANADA AND NEWFOUNDLAND

Imperial "RPM" DELO:
Imperial Oil Limited

IN BRITISH COLUMBIA AND ALBERTA

"RPM" DELO:
Standard Oil Company of British Columbia Limited

THROUGHOUT THE WORLD

"RPM" DELO is available through distributors in more than 100 countries.

CASE TRACTORS are great performers—have been for 47 years. So when New "RPM" DELO comes through extensive factory tests with the verdict—

"Satisfactory for Case Tractors operating on any fuel from gasoline to tractor fuel or distillate"—

This means it delivers cost-cutting, life-lengthening, profit-raising lubrication! Results of J. I. Case Company tests show: Combustion chambers free of carbon deposits—meaning cooler, smoother, sweeter-running engines! All rings free in the piston grooves. Blow-by and engine wear minimized—full-power performance assured. *Unfailing protection! Longer engine life!*

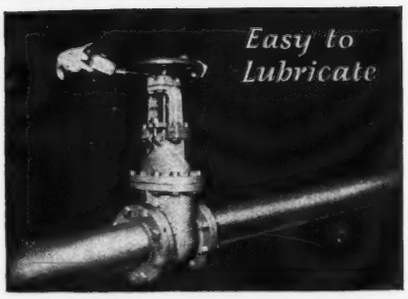
Profit by New "RPM" DELO in *your* equipment—in stationary, automotive, or marine service. It ends ring sticking. It's safe for *all* types of bearings.

RPM
DIESEL ENGINE LUBRICATING OIL

New "RPM" Diesel Engine Lubricating Oil now available everywhere in the gray barrel with the blue head

STANDARD OIL COMPANY OF CALIFORNIA

Saves Time at Every Operation



. . . . one of the Extra Values in Kennedy Iron-body Wedge Gate Valves

THE pipe fitter or machinist, the operating engineer, and the maintenance man all find that Kennedy Iron-Body Wedge Gate Valves save time at every operation.

For example, whenever these valves are to be opened or closed, the large five-spoke, oval-rim handwheel assures a firm, comfortable grip with ample leverage, the stem is prevented from binding by special provisions in both non-rising stem and outside screw and yoke types, and the disc is kept in alignment by long machined body guides. Bronze bushings at all stem contact surfaces protect the stem from corrosion that might cause sticking, rapid destruction or scoring and leakage at the packing.

Again, when the outside screw and yoke type is to be repacked, the rust-proofed stuffing box bolts loosen easily, the swing-type bolts drop out of the way, there are no separate washers to become lost, and shelves inside the yoke hold the gland up during repacking.

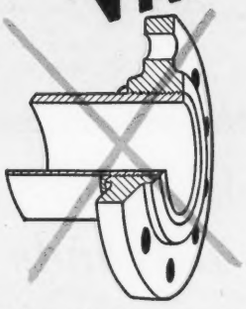
Every part of these valves have extra values that assure dependable control, long life and economical maintenance besides saving time at every operation. Bulletin describing these "Extra Value" Valves in detail will be sent on request.

The Kennedy Valve Mfg. Co., Elmira, N. Y.

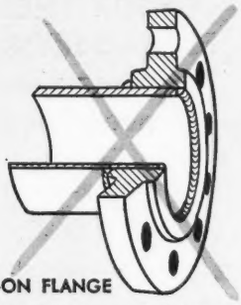
KENNEDY

Extra Value in VALVES

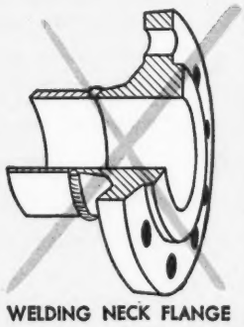
MIDWEST VAN STONE WELDING NIPPLE makes the *ideal* flanged joint for welded piping systems



SCREWED AND WELDED FLANGE



SLIP-ON FLANGE
WELDED FRONT AND BACK



WELDING NECK FLANGE

For making connections to boilers, pumps, valves and other flanged outlets (and where piping must be frequently cleaned or inspected for corrosion), Midwest Van Stone Welding Nipples have a tremendous advantage over flanges that are welded to the pipe (see drawings at left). The swivel flange of the Nipple makes it unnecessary to accurately line up the bolt holes before welding; "setting up" is simple and quick because no special clamps or jigs are required to hold the face of the flange absolutely perpendicular to the axis of the pipe. The result is a real saving in time and cost of welding.

Another important economy is in erection. Field organizations report a saving of 25% in erection time for making up a joint using Midwest Van Stone Welding Nipple in comparison with flanges rigidly fixed to the pipe; this saving is even greater when the flanges are on bends.

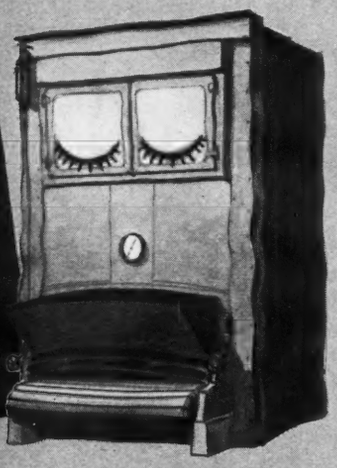
Ask for Bulletin WF-36 which gives complete data regarding Midwest Van Stone Welding Nipples . . . and other Midwest Welding Fittings that simplify and save on welded piping.

MIDWEST
PIPING & SUPPLY COMPANY, Inc.

Main Office: 1450 So. Second St., St. Louis, Mo.

Plants: St. Louis, Passaic (N. J.) and Los Angeles • Sales Offices: Chicago—946 Marquette Bldg. • Houston—1716 Second National Bank Bldg. • Los Angeles—520 Anderson St. • New York—(Eastern Division) 30 Church St. Tulsa—533 Mayo Bldg.

Wake up that SLEEPING BOILER CAPACITY!



Are your boilers keeping something from you?

In the majority of plants mud and sludge forms in the boiler regardless of whether the water is passed through a softener or treated in the boiler. This sludge causes priming and foaming. It must be removed before you can obtain a maximum of clean steam from your boilers. The Elgin Deconcentrator will remove this sludge that throttles boiler capacity.

Correct water conditioning will make your present boilers meet increased steam demands

WITH production climbing, the boiler plants of many industries are being asked to handle a bigger job. Does this mean expensive plant enlargement?

Before you answer yes, consider this: Loads *have* been light. High boiler capacity has *not* been a primary problem. Under these conditions it is easy to make the false assumption that boilers are not capable of handling increased loads, simply because they are not *doing it*.

There are scores of cases on record where the proper handling of boiler water conditioning has effected an almost incredible increase in boiler output. By eliminating scale formation, priming, foaming, carry-over, dirty steam, excessive blow-downs, and unnecessary shut-downs, operating men have found boiler capacity that they did not know they had. New boilers are expensive. Water conditioning is inexpensive. Moreover, by increasing over-all efficiency, proper boiler water conditioning pays for itself and then pays dividends.

ASK FOR AN ELGIN SURVEY

So before embarking on an expensive program, why not ask Elgin to work with you in determining what can be done with *present* equipment? No organization is better qualified to render this service. Elgin manufactures all types of equipment and supplies all types of chemical treatment. As a result, this organization is bound to only one course—the most satisfactory and economical method of accomplishing the results you should obtain. For the comprehensive Elgin Survey there is no cost or obligation of any kind.

CHECK THESE ELGIN SERVICES against your needs—

- √ Water softeners for every requirement (Including new Carbonaceous type).
- √ Internal treatments, specially compounded for individual needs.
- √ Sludge removal, by the Elgin Deconcentrator.
- √ Concentration control, by advanced Elgin Continuous Blowdown Heat-Exchanger System.
- √ Softener modernization and Zeolite refills that step up efficiency.
- √ Water Testing equipment.
- √ Corrosion elimination.
- √ Iron and "red water" elimination.
- √ Treatments to eliminate scale and lime deposits in water lines, condensers, boiler feed lines and cooling coils.
- √ Oil removal from condensate.
- √ Pressure sand filtration.
- √ Aerator systems.

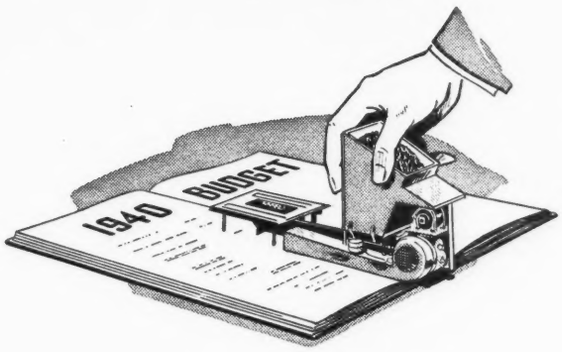
Elgin service includes regular plant inspection and complete laboratory service—a service that keeps your problem solved.

ELGIN SOFTENER CORPORATION, 55 NORTH STREET, ELGIN, ILLINOIS

Elgin Water Conditioning

"Devoted Exclusively to Water Conditioning Since 1908"

Put IRON FIREMAN *into your 1940 budget*



What other investment can earn so much for you? Decide now that in 1940 you will *modernize, Iron Fireman-ize* your boiler plant. Iron Fireman will step up operating efficiency to a new high, and at the same time earn an exceptional return on the investment.

For instance, *Bowser Pump,* Fort Wayne, Ind., is earning a 76% return on its Iron Fireman investment. *Massengill Laboratories,* Bristol, Tenn.-Va., is receiving a 39% annual return; and its 12 Iron Fireman stokers have given 50 years' combined service at a total service cost of only $29.20. *Patterson Mills,* Roanoke Rapids, N. C., is collecting annual cash savings amounting to 87% of its three Iron Fireman Powerams, with steam costs cut from 35 cents to 20.8 cents.

Let us make an Iron Fireman Engineering Survey of your plant. We cannot promise *you* such tremendous savings—unless your situation offers similar opportunities for improvement. But if you will authorize us to make a survey of your steam costs at our own expense, we will give you a conservative report showing what Iron Fireman *can* do. We will work in cooperation with your own engineer, consulting engineer, or fireman. The survey report can be incorporated, if you wish, in your 1940 budget recommendations. Send the coupon, and we will do the rest.

"Iron Fireman cut our fuel budget 20%"

. . . reports John K. Voehringer, Jr., president, Mock, Judson, Voehringer Co.

Greensboro, N. C., mill of Mock, Judson, Voehringer: one of the largest and finest full-fashioned hosiery mills in the South; where three Iron Fireman stokers have operated for 10 years.

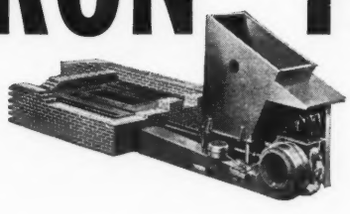
New hosiery mill in Siler City, N. C., where a new Iron Fireman *Poweram* underfeed stoker is providing low-cost steam.

In 1929 the Mock, Judson, Voehringer Company installed three heavy-duty Iron Fireman stokers in its boiler room. These stokers are now entering their second decade of operation—piling up fuel savings compared with hand-firing, at the rate of 20% a year. Maintenance cost on all three stokers combined, over the entire 10 years, has been only $350, reports President Voehringer. He adds that with Iron Fireman firing, "we maintain uniform pressure *regardless* of steam demands for processing work and heating. Boiler room expense has been reduced to a minimum through the use of lower-cost sizes of coal, reduction in tonnage burned, and reduction in labor required."

When the affiliated concern, the Siler City Hosiery Co., erected a new mill recently, a new Iron Fireman *Poweram* was promptly installed . . . making the fourth Iron Fireman heavy-duty stoker operated by Mr. Voehringer.

IRON FIREMAN

Automatic Coal Stokers



IRON FIREMAN MANUFACTURING CO., Portland, Ore.; Cleveland; Toronto.

Mail to 3177 West 106th Street, Cleveland, Ohio.

☐ See us about making an Iron Fireman Engineering Survey of our steam costs.

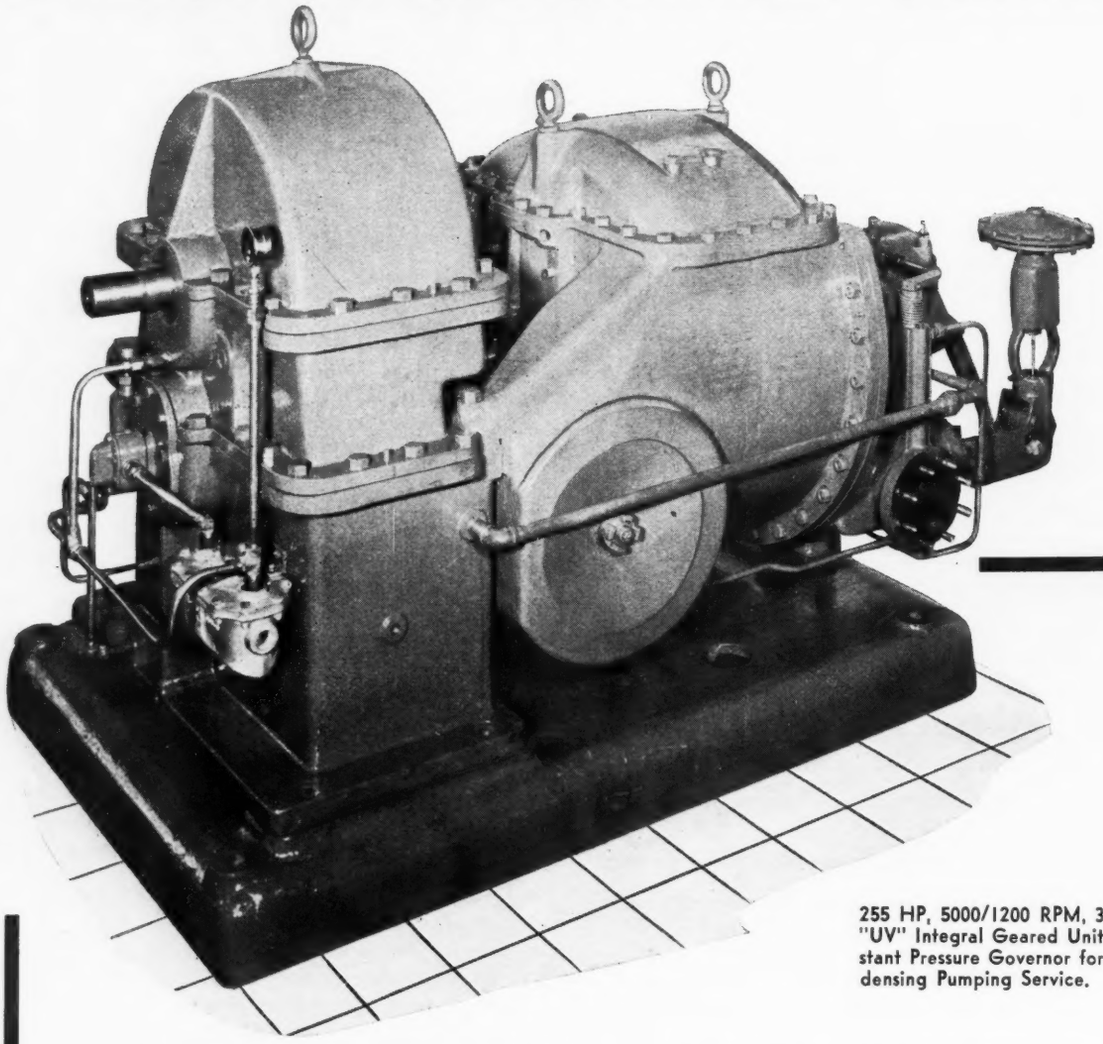
Send ☐ Industrial Power Catalog
☐ Commercial Heating Catalog.

Name_____

Address_____

MURRAY

TYPE "UV" MULTI-STAGE TURBINES with INTEGRAL REDUCTION GEARS . . .



255 HP, 5000/1200 RPM, 3-stage, Murray Type "UV" Integral Geared Unit with "built-in" Constant Pressure Governor for High Pressure Condensing Pumping Service.

MURRAY Type "UV" Multi-Stage Mechanical Drive Turbines

—plus—

MURRAY Integral Reduction Gears

—equal—

the correct answers to your mechanical drive problems demanding high efficiency with simple, rugged construction and minimum space requirements.

A complete line of sizes and types are available.

These modern MURRAY Steam Turbine Drives are daily delivering thousands of horsepower where reliability and economy are of utmost importance. The following are typical of many actual applications:

RECIPROCATING COMPRESSORS (thru "V" belts)
CENTRIFUGAL PUMPS
INDUCED DRAFT FANS
FORCED DRAFT FANS
COAL PULVERIZERS
JORDAN PAPER MACHINES

Our district representative, or our home office will furnish complete information promptly upon your request.

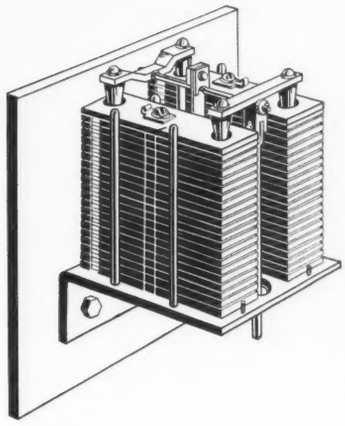
MURRAY IRON WORKS CO.

BURLINGTON IOWA

NEW SMALL DIACTOR REGULATOR

For $70 List

Brings dependable voltage regulation to the small machine



All Diactor regulators have this type of fast, smooth-action rheostatic element—the only element that provides an infinite number of smooth resistance steps from practically zero to the maximum.

YES, there's a new small Diactor regulator in this outstanding line of General Electric generator-voltage regulators. It's the new Type GDA-29 for use with a-c generators, 31.3 kva and smaller, having self-excited exciters. Now you can equip machines in this size class with Diactor regulators built specially to do this job—at a cost that takes dependable voltage regulation for these small generators out of the luxury class.

Is a Full-fledged Regulator

This small regulator is the same as other Diactor regulator models in every way except size. It has the same quick-action, wide-range rheostatic element—the only element that provides an infinite number of smooth resistance steps from practically zero to the maximum. And the regulation curve obtained with it is correspondingly smooth. The enclosing case prevents the entrance of dust and dirt and gives the regulator a smooth, streamline appearance.

A Complete Line—Six Ratings

G-E Diactor regulators are available in six different ratings—for generators rated 18,750 kva at 3600 rpm, and smaller machines at correspondingly lower speeds. This complete line makes it easy for you to select regulators in correct ratings to meet your needs. A specialist in the nearest General Electric office can give you detailed information. Or use the coupon below to obtain Bulletin GEA-2022C. General Electric, Schenectady, N. Y.

General Electric Co., Dept. 6K
Schenectady, N. Y.

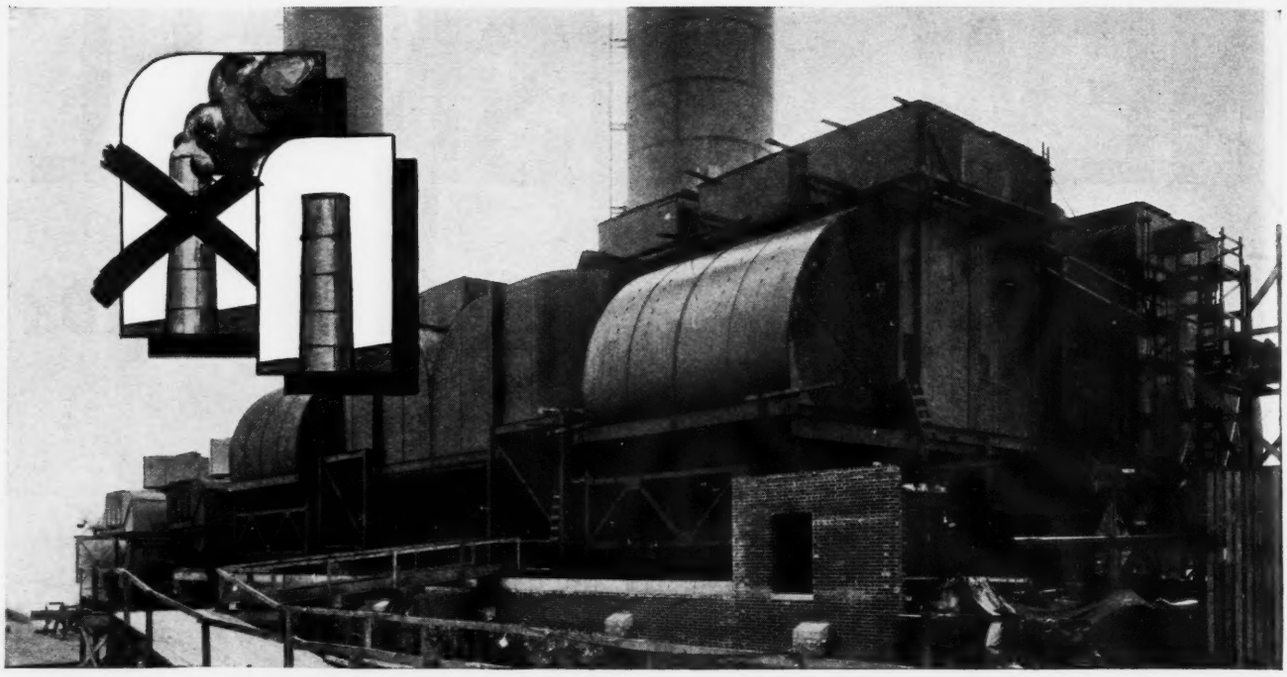
Please send me a complete description of the new line of Diactor generator-voltage regulators. (GEA-2022C)

Name .....

Company .....

Address 630-17

GENERAL ELECTRIC

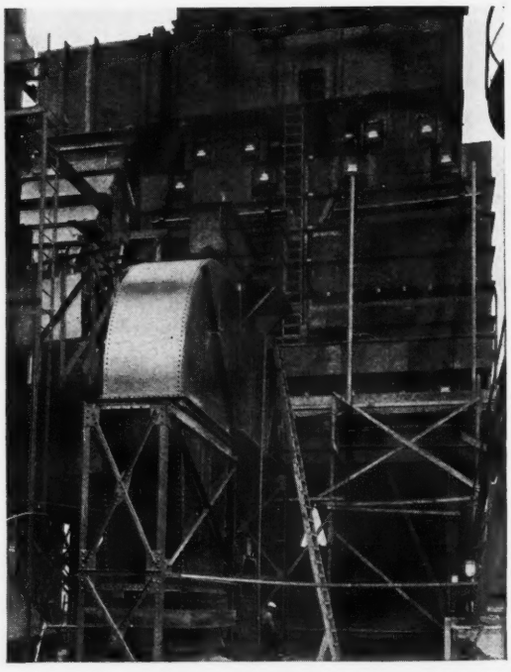


NO SMOKE ORDINANCE IS TOO DRASTIC FOR COTTRELLS

● Instantaneous, complete and continuous precipitation of fly ash is one of the many outstanding performances of Cottrell Electrical Precipitators. Installations now operating at powdered fuel power plants are handling an aggregate of 45,000,000 c.f.m., representing a total collection of TEN TONS OF SOLIDS PER MINUTE.

● Samples of fly ash examined by our engineers usually show from 50 to 60 per cent of the particles with sizes smaller than 20 microns. These small sizes cannot be effectively collected by ordinary mechanical collectors, but are readily deposited by Cottrells, with efficiency up to 99 per cent or better. Cottrell performance is remarkable because of its high efficiency, low draft loss, low power cost, low labor and maintenance costs and exceptionally long life in sustained service.

●



MULTICLONES

are the original small tube "dust" collectors, with exclusive patented features that give them high efficiency and economy. They are recommended where the higher efficiency of Cottrells is not required.

DUST DETERMINATIONS

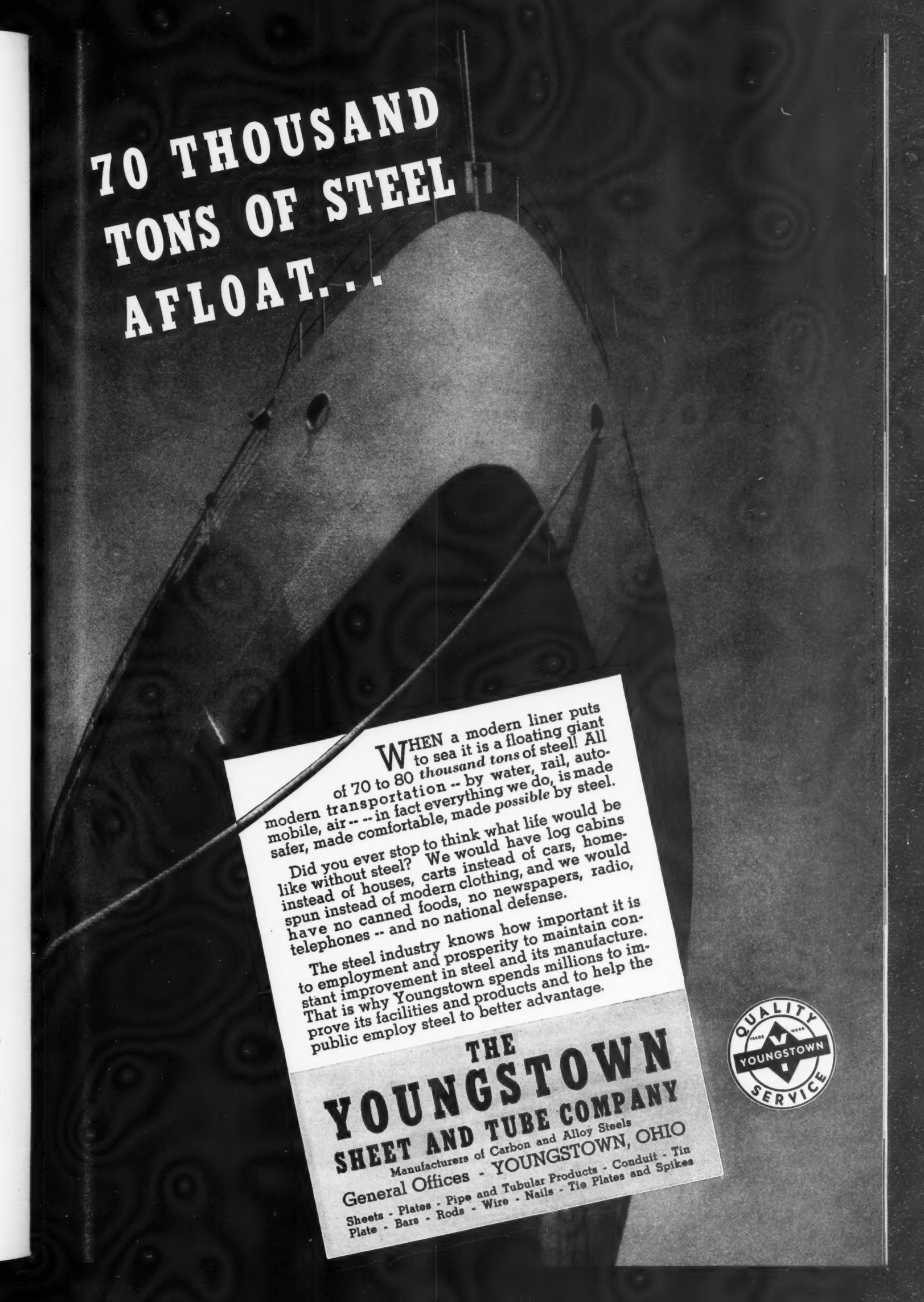
● In our 33 years of international experience, we have developed accurate scientific methods of making dust determinations under all operating conditions. State your problem and we will be glad to give you the benefits of our experience.

RESEARCH CORPORATION
CHRYSLER BLDG., NEW YORK, N.Y.
59 E. VAN BUREN ST., CHICAGO, ILL.

WESTERN PRECIPITATION CORPORATION
1016 W. 9TH ST., LOS ANGELES, CALIF.
405 LEXINGTON AVE., NEW YORK, N.Y.

A COTTRELL GUARANTY HAS AUTHORITY

● The performance of every Cottrell Electrical Precipitator is specifically guaranteed without evasion or subterfuge. A Cottrell guaranty is based on the percentage of collection of total solids entering the collector and is backed up by adequate financial resources and records of successful performance in all industries all over the world. In the long run, this is the only index of saving and safety.



WHEN a modern liner puts to sea it is a floating giant of 70 to 80 *thousand tons* of steel! All modern transportation -- by water, rail, automobile, air -- -- in fact everything we do, is made safer, made comfortable, made *possible* by steel.

Did you ever stop to think what life would be like without steel? We would have log cabins instead of houses, carts instead of cars, homespun instead of modern clothing, and we would have no canned foods, no newspapers, radio, telephones -- and no national defense.

The steel industry knows how important it is to employment and prosperity to maintain constant improvement in steel and its manufacture. That is why Youngstown spends millions to improve its facilities and products and to help the public employ steel to better advantage.

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon and Alloy Steels

General Offices - YOUNGSTOWN, OHIO

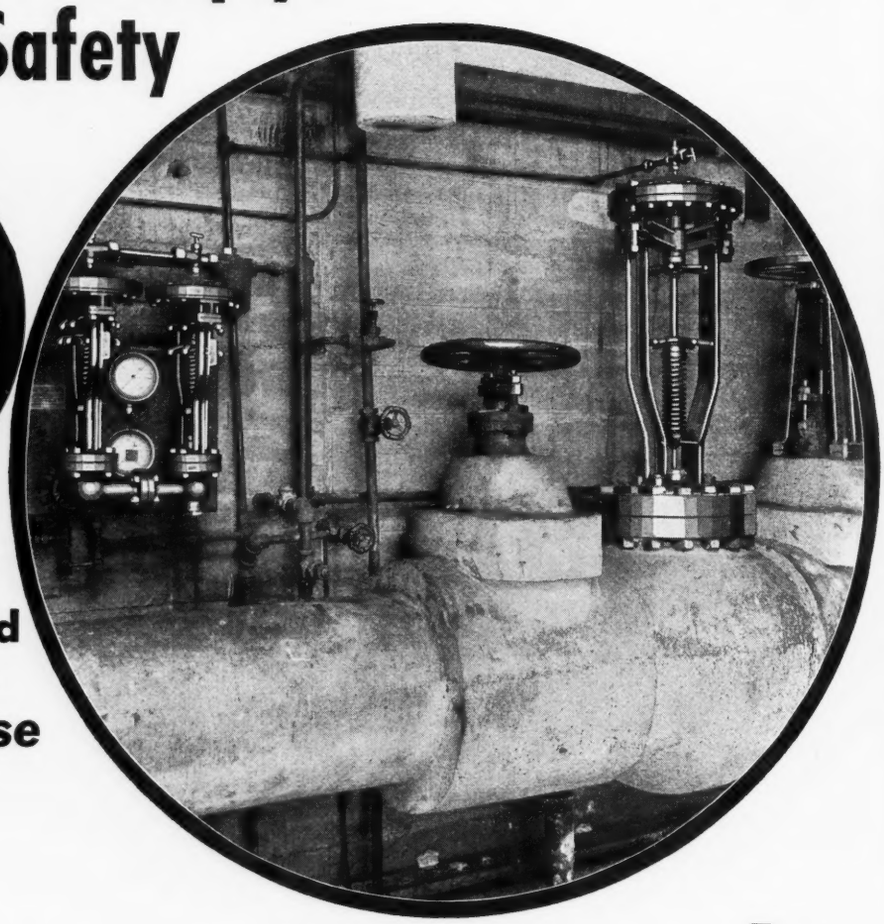
Sheets - Plates - Pipe and Tubular Products - Conduit - Tin Plate - Bars - Rods - Wire - Nails - Tie Plates and Spikes

QUALITY YOUNGSTOWN SERVICE

Studebaker Still Enjoys Swartwout Safety

After 11 Years

of Pressure Control without trouble and with *almost no upkeep expense*



HERE is an enviable record of low cost efficiency you can duplicate in your plant. Swartwout Master Control and Swartwout Pressure Control Valves bring dependable safety and savings in operating costs wherever pressure rules.

The pictured installation — one of many in the Studebaker Corporation plant at South Bend — consists of a twelve inch Swartwout Type "C" Valve operated by a Class "C" Master which is the forerunner of the present type "CPM" Swartwout Master Control. *Since early in 1928, this equipment has given completely satisfactory service at an average of less than $5.00 annual maintenance cost.*

Actually, such results are common performance for Swartwout Controls. Their rugged construction throughout, our careful selection of the right materials for each part and our high manufacturing standards assure you the most service for the least money over a long period of time. More than thirty-five years' experience with all kinds of pressure control problems are back of our guarantee.

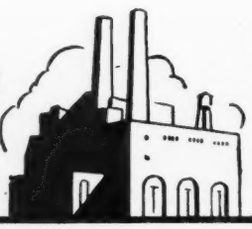
You can take personal pride in what Swartwout Controls do for the efficiency of your plant, as thousands of engineers have experienced it. Send today for Bulletin S-22-B, or write us the details of your problem.

Swartwout Controls are adapted to a wide variety of uses — maintaining constant pressure, differential control, variable pressure, etc., with completely automatic dependability....

Feed Water Regulators • Pump Governors • Feed Water Heaters
Master Controls • Reducing Valves • Separators • Exhaust Heads

Swartwout

•Power Plant Equipment



THE SWARTWOUT COMPANY
18501 Euclid Ave., Cleveland, Ohio

"THAT J-M ENGINEER WAS RIGHT... HE *HAS* REDUCED OUR FUEL COSTS"

...a common occurrence... duplicated in thousands of plants throughout the country. And in your plant, too, a J-M Insulation Engineer can cut fuel or refrigeration costs and provide more accurate temperature control...

NO ONE INSULATING MATERIAL is best for every service . . . even in a small plant many different types and thicknesses are needed to meet varying requirements. Yet, because of their specialized nature, it is often difficult for the plant engineer to decide just which material will be most economical.

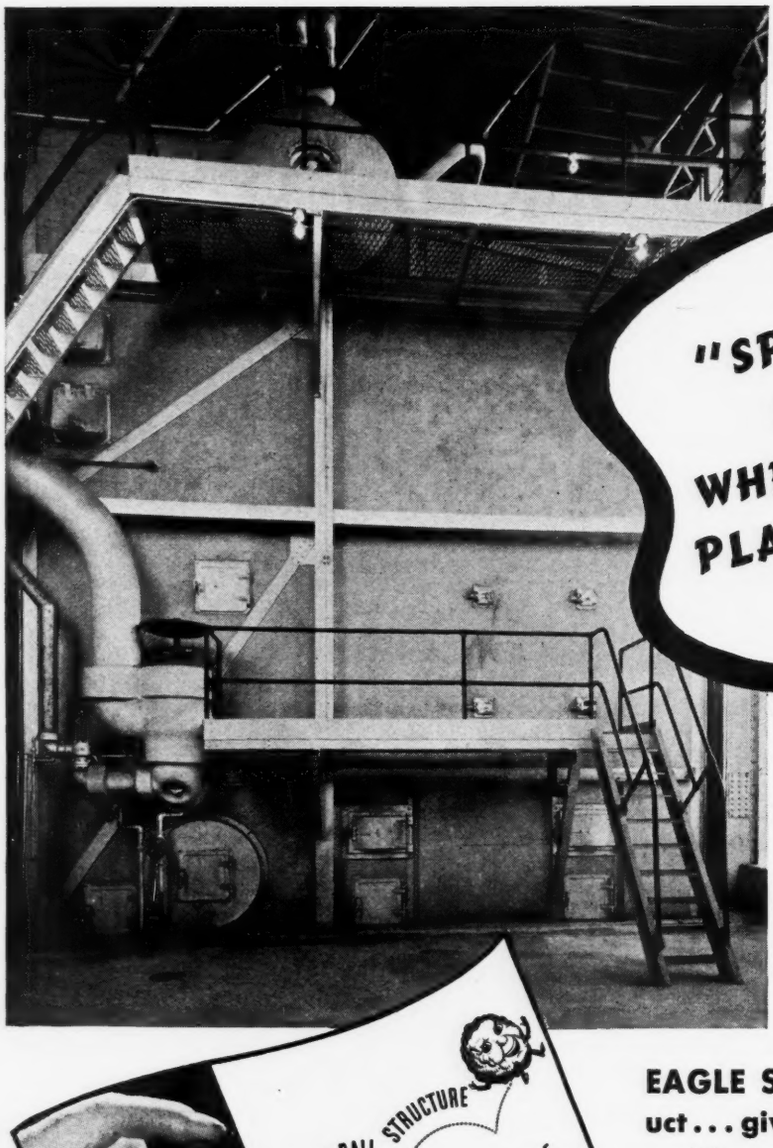
And that is where a Johns-Manville Insulation Engineer can help. These men are fully qualified to recommend the one *correct thickness* of the one *right material* that will serve better, more economically than any other.

With more than forty different types of J-M Insulations to choose from . . . in every desired form and thickness . . . and covering the entire temperature range, from far below zero to over 3000° F. above . . . the recommendations of a J-M Engineer are entirely unbiased. His only concern is to select those materials that will give you the greatest possible return on your investment and the most accurate control of temperatures.

During the last ten years J-M Insulations have saved American industry $250,000,000 annually. Why not make sure your plant is getting its full share of this huge saving? Write for a J-M Engineer today . . . his services are free and his recommendations may save you money. Or, for complete information on J-M insulations, write for Brochure IN-55A. Address Johns-Manville, 22 East 40th Street, New York, N.Y.

Johns-Manville INDUSTRIAL INSULATIONS

FOR EVERY TEMPERATURE... EVERY SERVICE CONDITION



New Arkansas Power & Light Company boiler insulated with 1½" of Eagle Super "66."

INSIST ON "SPRINGY BALL" STRUCTURE WHEN YOU'RE BUYING PLASTIC INSULATION!

EAGLE SUPER "66" . . . an improved product . . . gives remarkable efficiency because of its resilient ("springy ball") structure

A simple thumb-and-finger test will show you why Eagle Super "66" is such economical, effective insulation.

The "springy ball" structure of these tiny mineral wool pellets does not collapse when the pellets are mixed with water and troweled on the job.

Dead air cells are retained intact to maintain thermal efficiency for temperatures as high as 1800° F.—to increase coverage—to minimize shrinkage.

Eagle Super "66" has a dry coverage between 50 and 55 sq. ft. 1" thick per 100 lbs. 100% reclaimable up to 1200° F. Write for sample.

EAGLE-PICHER INSULATING MATERIALS ALSO INCLUDE . . .

Eagle Blanket Insulation. For temperatures to 1200° F. on boilers, breeching, furnaces.

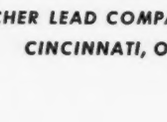
Eagle Insulseal (waterproofing cement). Protects insulation against exposure.

Eagle "77" Felted Mineral Wool Pipe Covering. Secured between metal fabrics. Easy to apply.

Eagle "88" Felted Mineral Wool Pipe Covering. Equipped with heavy galvanized ingot-iron jacket. Easily removed.

Eagle Stalastic (boiler setting cement). Stops air infiltration through masonry, boiler and furnace walls.

FOR FURTHER INFORMATION



WRITE FOR FREE BOOKLET

THE EAGLE-PICHER LEAD COMPANY

CINCINNATI, OHIO

EAGLE EP PICHER

EAGLE
INDUSTRIAL INSULATION

Yes ALL OF THESE FEATURES IN ONE ENGINE

The type S HEAVY-DUTY DIESEL ENGINE

Low Fuel Consumption. The extremely low fuel consumption of .38 lb. per b.hp.-hr. is largely the result of the distinctive Type S combustion system. A specially shaped intake passage sets up a rotational turbulence which intimately mixes the incoming air with fuel sprays from the opposed injection nozzles—the secret of perfect combustion.

Unusual Compactness—Small Parts. This heavy-duty engine can be put through an opening less than 6' x 9'. It stands only 7' high—no platforms are necessary. It is easily trucked fully assembled. Its small, comparatively lightweight parts are easily serviced.

Controlled High-Velocity Cooling. Directed high-velocity flow of water provides efficient cooling and prevents hot spots and steam pockets. A built-in circulating water pump can be furnished.

Flywheel-End Drive for Governor and Camshaft. The governor and camshaft are geared to the flywheel end of the crankshaft, providing the smooth and steady drive necessary for accurate and stable speed control. Reliable governors are provided for constant speed, variable speed or extra sensitive control as required.

Complete Force-Feed Lubrication. Automatic force-feed lubrication with continuous filtration and cooling to the governor and the valve mechanism, as well as to all bearings, prolongs the life of all wearing parts, increases reliability and simplifies operation.

Reliable Fuel System. To assure trouble free operation, the fuel system incorporates: a gear-driven supply pump; air separator; duplex filters; individual injection pumps equipped with patented I-R valves which prevent dribbling; and twin opposed, non-clogging injection nozzles.

And Many Other Refinements. These include: precision-type shell bearings which eliminate "scraping in"; wet cylinder liners; four-bolt connecting rod boxes; fully counterweighted crankshaft; extra filter for governor lubrication, and full-floating piston pins.

Nothing has been omitted that would aid in reliability, safety and ease of operation.

THESE FEATURES RESULT IN LOW OVER-ALL POWER COSTS

The Type S is a 4-cycle, solid-injection engine rated for continuous full-load service. It is built with 3 to 8 cylinders from 175- to 510-b.hp. at 600-rpm.

The combination of its features results in low cost of transportation, of installation, of operation, and of maintenance—consequently low over-all power costs.

Other I-R Products include: Gas Engines, Compressors, Pumps, Condensers, Rock Drills, Pneumatic Tools, and Refrigerating Units.

Atlanta
Birmingham
Boston
Buffalo
Butte
Chicago
Cincinnati
Cleveland
Dallas
Denver
Detroit
Duluth
El Paso
Hartford
Houston
Kansas City

Ingersoll-Rand

11 BROADWAY, NEW YORK, N. Y. 690-7

Knoxville
Los Angeles
Newark
New York
Philadelphia
Picher
Pittsburgh
Pottsville
Salt Lake City
San Francisco
Scranton
Seattle
St. Louis
Tulsa
Washington

The busier you are

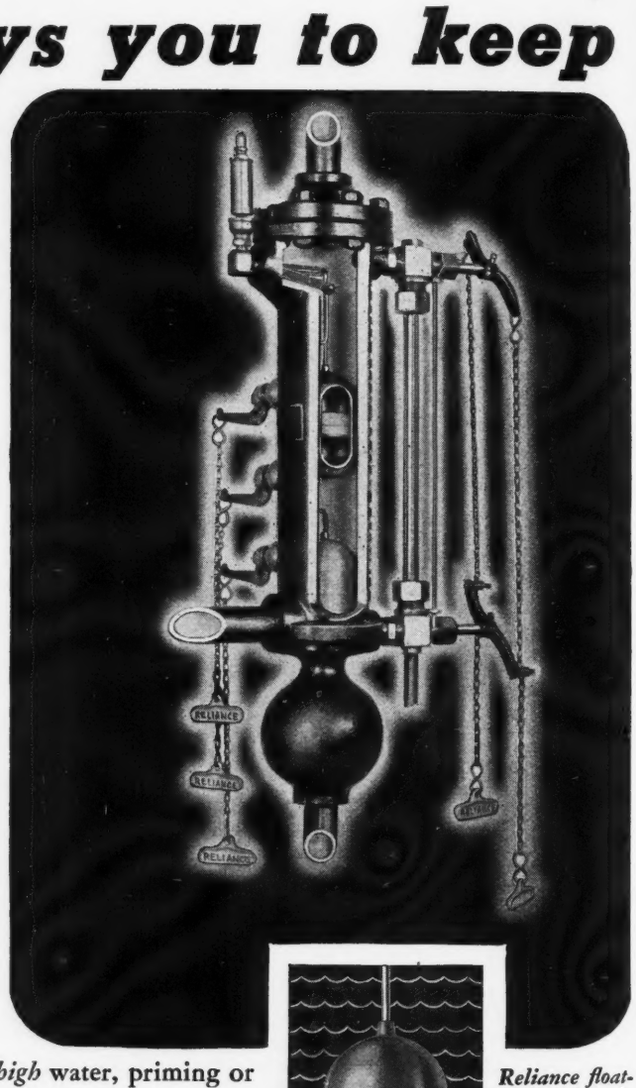
the more it pays you to keep power flowing—

UNINTERRUPTED

Avoid the risk of costly shut-downs with dependable

Reliance

WATER LEVEL ALARMS

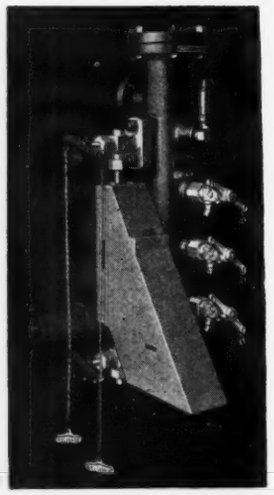


THE harder your plant is being pushed, the less you can afford any risk of power interruption. Reliance Alarms prevent burned out tubes, cracked headers, bulged sheets and serious explosions by giving an unmistakable whistle or electric warning when boiler water level *drops* dangerously.

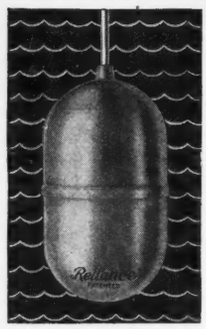
They warn you also against *high* water, priming or slugs of water carried over into superheater, turbine or engine. Easy to install, relatively inexpensive. (cost as little as $27.50.)

Sturdily made of modern metals, there's a size or type for any boiler—all pressures. Reliance Alarm Water Columns have been the standard protection against fluctuating boiler water levels for fifty-five years. More than 165,000 have gone into service and not one has been known to fail in an emergency.

Under present profitable rush conditions is a good time to get credit for safe continuous boiler operation. Make sure of your water level control with Reliance Alarms. Write today for full information.



Reliance Alarm for 600 lbs. w. s. p. equipped with Reliance Micasight, forged steel gauge valves and cocks, illuminator and magnifying hood.



Reliance float-operated mechanism is quick, sensitive, dependable. Reliance floats are guaranteed unsinkable in the service for which specified

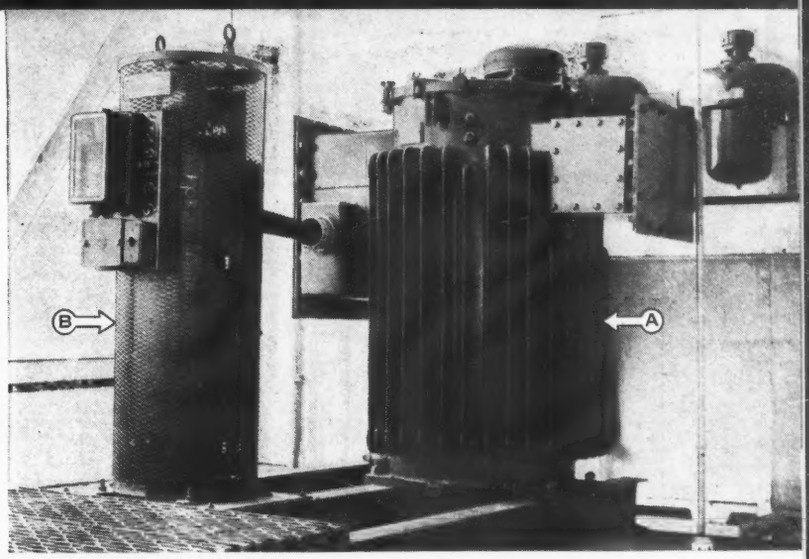
The Reliance
GAUGE COLUMN CO.
5902 Carnegie Avenue, Cleveland, Ohio

BOILER SAFETY DEVICES since 1884

Reliance

Specify G-E Pyranol Transformers for All INDOOR Installations

You can install them right at the load center, without costly vaults, because Pyranol is noninflammable

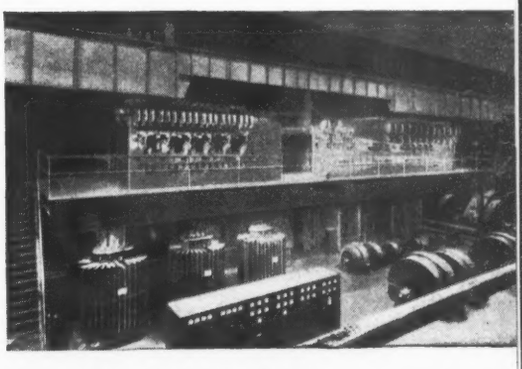


G-E Pyranol transformer (A) installed near the ceiling at the center of a modernized lighting circuit. G-E air-cooled regulator (B) provides precise voltage control for the lamps

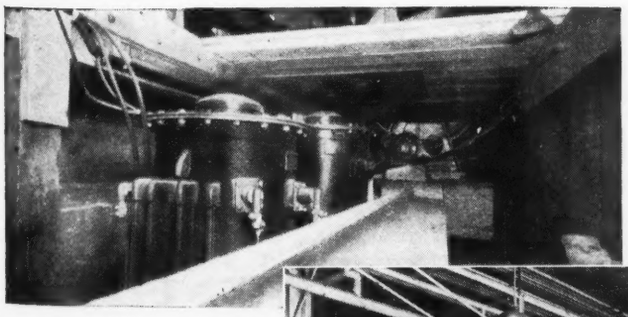
Use Them to Modernize Your Lighting Circuits

THINKING of improving the lighting in one of your buildings? Maybe you can save your present wiring by dividing the circuit into several sections and installing a G-E Pyranol transformer at the center of each section. Keep your present secondary wiring and run small 2300-volt primary copper to serve the transformers. Savings as high as 40 per cent have been made by this method. The technique is completely described in Bulletin GEA-3180. Ask your G-E representative for complete information on Pyranol transformers to meet your requirements, or write General Electric Co., Schenectady, N. Y.

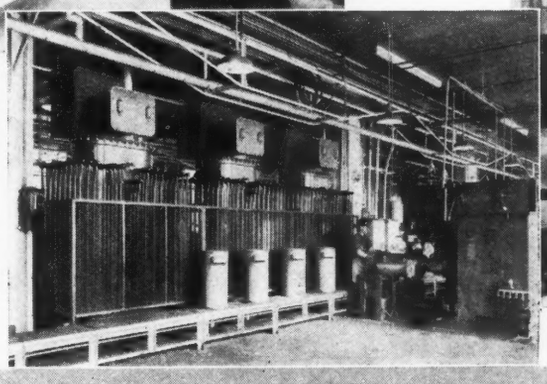
Use Them for Your Power Circuits and Enjoy the Benefits of Load-center Distribution



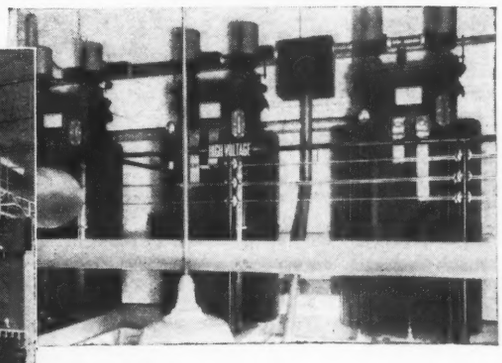
(Right) Load-center distribution at Jones & Laughlin Steel Corporation plant. Note locations of G-E Pyranol transformers right at the load, with no enclosing vaults



(Above) At the Boston Woven Hose & Rubber Company plant, marked savings were made because it was possible to install G-E Pyranol transformers in the nonproductive area right under the floor



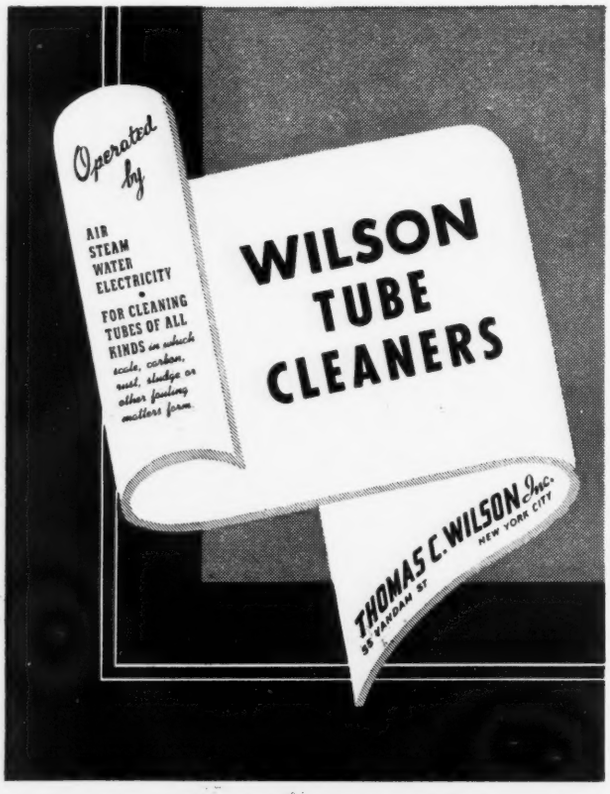
(Right) G-E Pyranol transformers saved the day for us at our Pittsfield Works. Three 635-kva Pyranol transformers located right beside heavy-current-consuming resistance-welding machines on an upper floor cut costs and losses



By mounting these Pyranol transformers on steel beams above the floor level, Acme Breweries, San Francisco, conserved floor space in its engine room. Savings in installed cost were realized because no vault was necessary

GENERAL ELECTRIC

300-72



ALWAYS—IN ALL WAYS—ALL WILSON CLEANERS GIVE SATISFACTION

Every Wilson cleaner—small or large—is so well designed, so simple in construction, so strongly made and so carefully assembled and tested that trouble-free, efficient and economical performance—coupled with long life—are assured. Wilson motors have more starting torque and deliver more power to the cutter head than other motors of the same size—and do it with the use of less air—and thus save time, labor and money.

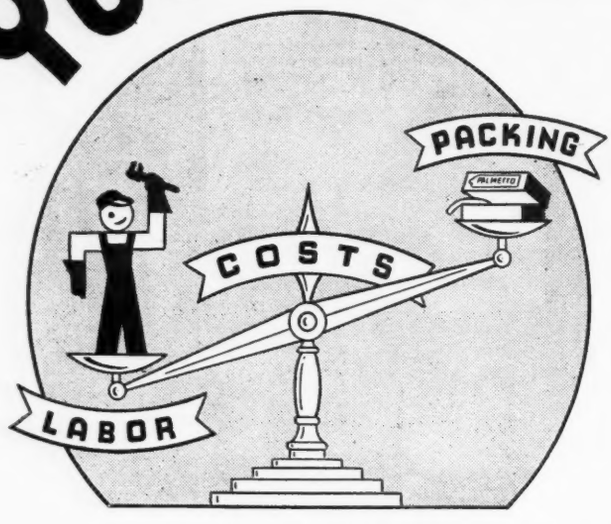
There is a Wilson cleaner to meet every tube cleaning need—every kind of deposit and every size of tube that is cleanable—whether made of steel, copper, brass or other metal or alloy.

Write us for our new thirty-six page catalog fully describing and illustrating the complete line of Wilson tube cleaning equipment.

THOMAS C. WILSON, INC., 55 VANDAM STREET, NEW YORK CITY

Pipe and Tube Cleaners Exclusively

YOU KNOW..



IT COSTS MORE TO REPACK A PUMP THAN THE PRICE OF THE PACKING ITSELF

PALMETTO
REG. U.S. TRADE MARK
PACKING
for **STEAM** *and* **COMPRESSED AIR**

REPACK WITH LUBRICATED PACKINGS THAT LAST
AND SHOW REAL SAVINGS

GREENE, TWEED & CO.
SOLE MANUFACTURERS
101 PARK AVE. NEW YORK, N. Y.

SQUARE PALCO
REG. TRADE MARK
PLAITED PACKING
for **WATER**

PUT THE BRAKES ON HIGH ROPE COSTS!

Lowest general-average rope operating cost is assured through the use of Roebling "Blue Center" Wire Rope. The result of continuous research and development, this rope is the finest product of Roebling's unexcelled research, steel-making and rope-fabricating facilities. Ask about Roebling's "Blue Center" Wire Rope ... either standard or preformed.

JOHN A. ROEBLING'S SONS COMPANY, TRENTON, N. J.
BRANCHES IN PRINCIPAL CITIES

STRONGER—Wire of highest strength consistent with ductility and toughness

TOUGHER—Provides maximum resistance against wear, sudden shocks, vibration

SAFER—Unequalled for uniformity of quality

SAVING—Insures lowest general average operating cost

THE HIGHEST DEVELOPMENT IN ROEBLING WIRE ROPE

FOR THE THREADING OF BOLTS OR ROD

—we suggest a "TOLEDO" No. 101 or No. 102 Adjustable Bolt Die Stock. Quick, positive adjustment for over or undersize as well as standard threads—the knurled adjusting ring does the trick—turn knurled ring until desired size is reached. Dies are segmental and are easily reground or replaced at small cost. No. 101 threads 1/4" to 5/8" U.S.S. or S.A.E. and measures but 17" overall. No. 102 threads 1/2" to 1" U.S.S. or S.A.E. and measures but 25 1/2" overall. These small bolt stocks are remarkably handy and well built. For complete details see your local dealer or write us.

A SMALL METAL BOX HOLDING STOCK AND DIES AND BUSHINGS CAN BE SUPPLIED FOR NO. 101 OR NO. 102.

THE TOLEDO PIPE THREADING MACHINE CO.
TOLEDO, OHIO **NEW YORK OFFICE, 72 LAFAYETTE ST.**

"TOLEDO"
TRADE-MARK REGISTERED U.S. PAT. OFFICE

YOU'LL DO BETTER WITH A "TOLEDO"

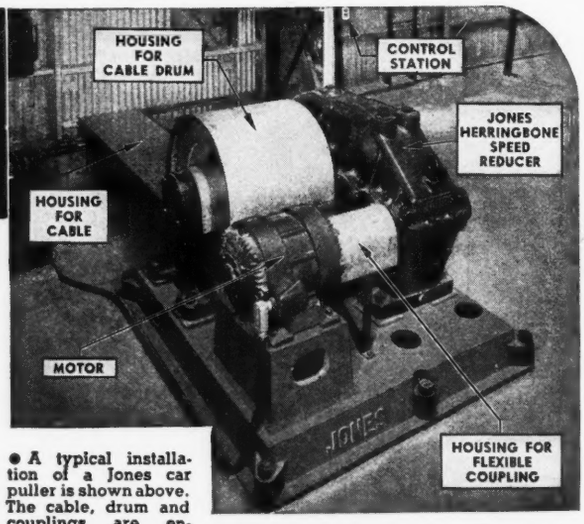
For spotting your cars- JONES CAR PULLERS

YOU will be surprised how much time can be saved in the spotting and switching of cars by using a Jones car puller. These sturdy, compact units will speed up car handling to the point where they soon pay for themselves in the saving of time and labor.

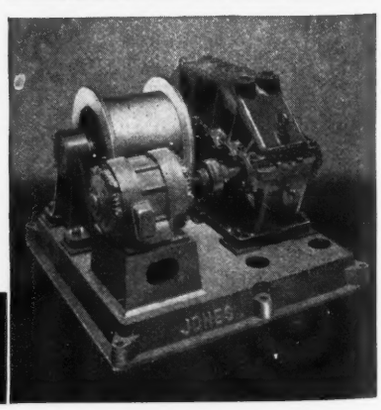
These car pullers are built by Jones as complete units with motor included if desired, or with base to take standard motor, as supplied by the purchaser. The cable drum is driven by a Jones triple reduction Herringbone speed reducer and the control station may be located at a point to give the operator a clear view of the tracks and spotting positions.

Even in plants where comparatively few cars are handled it has been found that a Jones car puller more than pays its way. Prices and complete information will enable you to judge whether such an outfit might pay out in your plant. Write for complete information.

W. A. JONES FOUNDRY & MACHINE CO.
4423 Roosevelt Road, Chicago, Illinois



● A typical installation of a Jones car puller is shown above. The cable, drum and couplings are enclosed by sheet metal housings as an extra precaution in this installation to eliminate all hazard from moving parts.

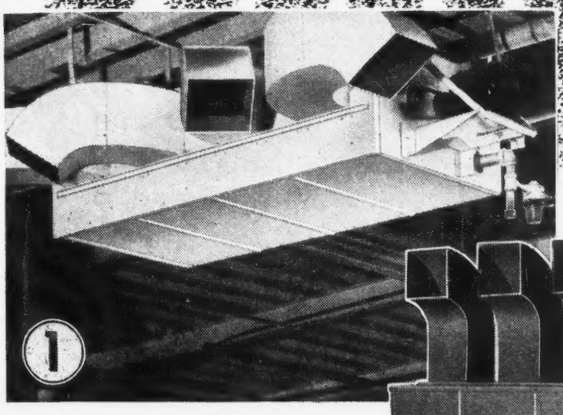


● A complete Jones car puller unit. These outfits are for use with wire rope and are manufactured in a wide range of capacities to suit the number of cars to be handled in each plant.

Jones

HERRINGBONE—WORM—SPUR—GEAR SPEED REDUCERS
CUT AND MOLDED TOOTH GEARS • V BELT SHEAVES
ANTI-FRICTION PILLOW BLOCKS • PULLEYS
FRICTION CLUTCHES • TRANSMISSION APPLIANCES

"CLARAGE was right —those Unit Heaters have cut our fuel costs plenty!"



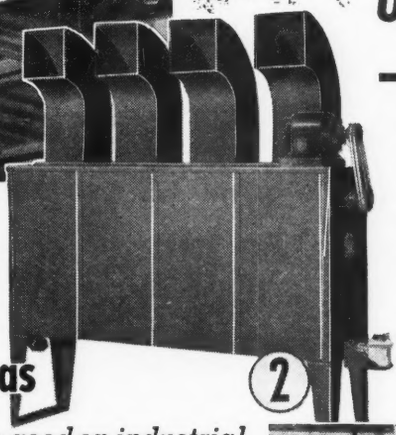
Unsurpassed Performance —and Low Maintenance

Shrewd buyers come back to us time and again for more of these highly-efficient, dependable heating units. One automobile company has reordered nineteen times—a steel company eight times—a paper mill six times, and so on.

To make SURE of trouble-free service, we balance the fan wheels BOTH statically and dynamically; use larger shafts; provide a bent-tube safety coil.

If you're after REAL ECONOMY, try CLARAGE the next time you have a heating problem, no matter how large or how small.

ECONOMICAL HEATING for Large and Small Areas



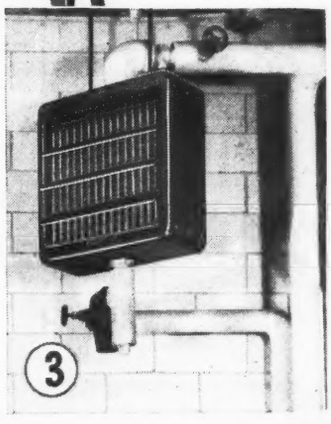
Clarage Unit Heaters make good on industrial jobs—in factories, mills, warehouses, etc. . . . also widely used in garages, stores and offices.

1. *Suspended Unitherm Unit,* scientifically designed for heating large spaces. Equipped with high-velocity, centrifugal fans insuring uniform diffusion and rapid heating pick-up. Square outlets adjustable four ways.

2. *Floor Mounted Unitherm Unit,* another large area heater of similar design. Both types of Unitherms can be furnished with CLARAGE Syncrotherm Control which guarantees even greater fuel savings.

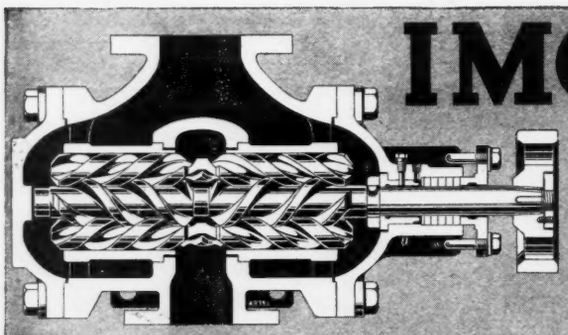
3. *Suspended Clarco Unit,* ideal for heating small spaces, or where more heat is needed than present equipment can supply.

Immediate Delivery can be made on practically any size in either type. *Write us today for literature.*



COMPLETE AIR CONDITIONING
•
COOLING
•
VENTILATION
•
FACTORY HEATING
•
MECHANICAL DRAFT
•
FANS and BLOWERS for INDUSTRIAL NEEDS

CLARAGE FAN COMPANY—KALAMAZOO, MICH.
SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

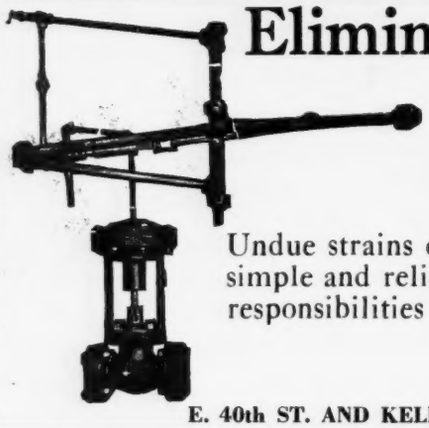


IMO *means* "I Move Oil"

De Laval-IMO Oil Pumps are being widely used for handling the heaviest fuel oils, in large volumes and against high pressures, as well as for light Diesels and lubricating and hydraulic pressure oils. They are directly connected to standard speed motors and turbines, have perfect rotational balance, and give rise to neither vibration nor pulsation. There are only 3 moving parts; no valves, no gears, no outside bearings, and only one stuffing box.

Ask for Catalog 1-39

DE LAVAL STEAM TURBINE CO., *Trenton, N. J.*



Eliminate Needless Dangers with a *Squires* BOILER FEED WATER CONTROLLER

Undue strains on the boilers can be eliminated by installing this simple and reliable feed water controller. It will shoulder human responsibilities with exacting precision.

Write for full particulars A-12.

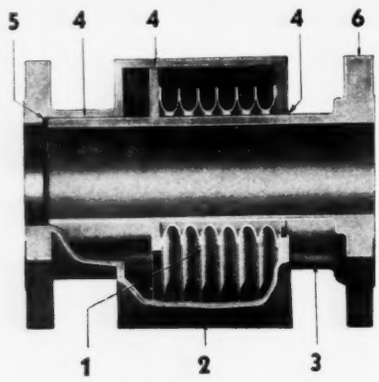
Trade Mark Reg. U. S. Patent Office

THE C. E. SQUIRES CO.

E. 40th ST. AND KELLEY AVE. CLEVELAND, OHIO

ADSCO PACKLESS, U-RING EXPANSION JOINT

COMPACT AND SIMPLIFIED DESIGN WITH FLEXIBLE STEEL ELEMENT FOR HIGH PRESSURE, HIGH TEMPERATURE SERVICE



(1) Expansion Element of corrosion resistant steel (2) Steel Body (3) Movable Sleeve (4) Three-point guiding for Sleeve (5) Limit Stop (6) Flanged or beveled ends for welding.

CORROSION RESISTANT STEEL EXPANSION ELEMENT

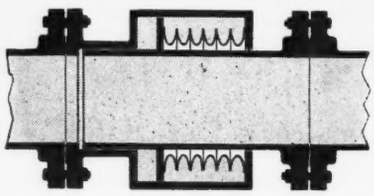
Under least Strain when in Service

The only packless expansion joint where the expansion element is under compression when in operation and under minimum flexing strain when in service.

The expansion element is a series of corrosion resistant steel U-Rings welded to the steel body and to the guide on the sleeve, forming a permanent seal between the stationary body and the movable sleeve. The steel body is similar in quality and thickness to the pipe itself. A full, unrestricted opening is provided through the joint by the movable sleeve.

Especially suitable for installation in underground or surface pipe lines in inaccessible locations—requires no maintenance. Available with flanged or beveled ends, with or without anchor base for pressures to 300 lbs.

Write for new Bulletin No. 35-50A.



How It Operates

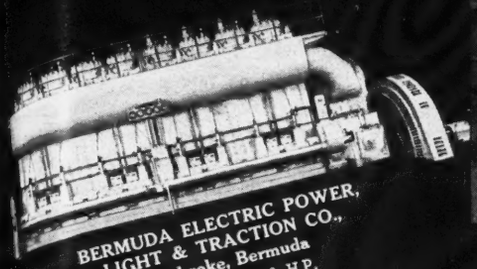
Diagrammatic sketch above illustrates the principle of operation. The dotted area represents the steam space through the joint and around the outside of the element. The inside of the element is under atmospheric pressure and the line pressure is on the outside of the element. No dirt or scale can enter the element to interfere with its operation.

AMERICAN DISTRICT STEAM COMPANY

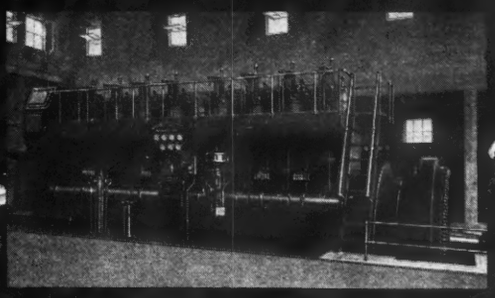
NORTH TONAWANDA, N.Y.

IN BUSINESS OVER SIXTY YEARS

NORDBERG DIESELS
IN CENTRAL STATION SERVICE

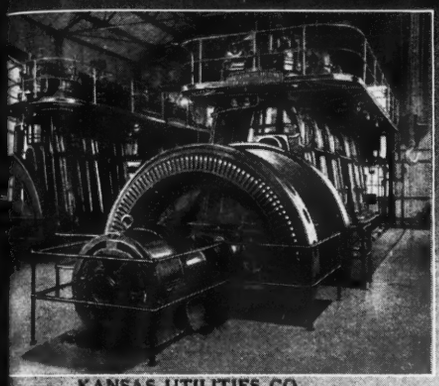


BERMUDA ELECTRIC POWER, LIGHT & TRACTION CO.,
Pembroke, Bermuda
One unit — 3,200 H.P.

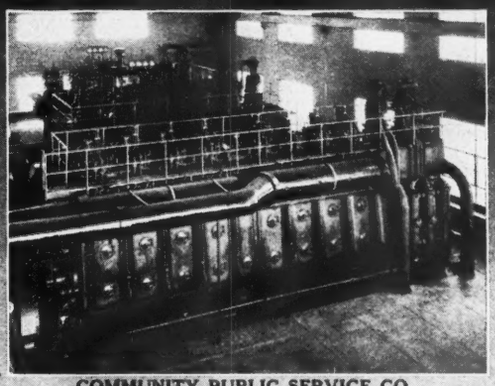


OTTERTAIL POWER CO.,
Appleton, Minn. — Langdon, N. D.
Three units — 5,280 H.P.

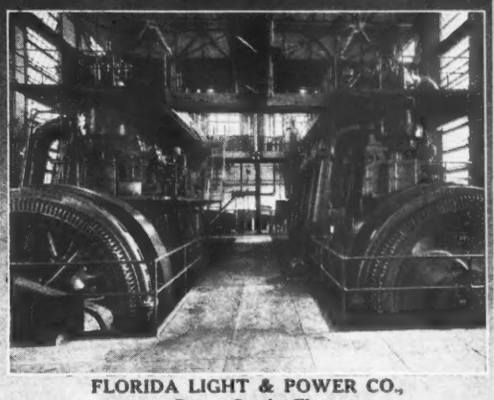
WESTERN PUBLIC SERVICE CO.,
Chadron, Nebr.
One unit — 2,000 H.P.



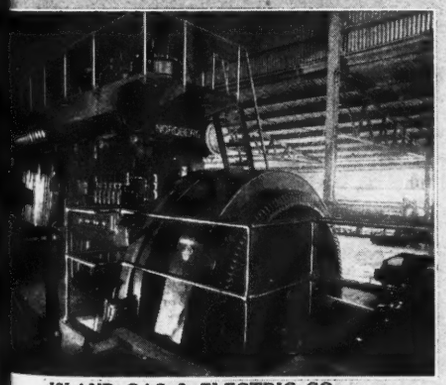
KANSAS UTILITIES CO.,
Humboldt, Kansas
Two units — 2,500 H.P.



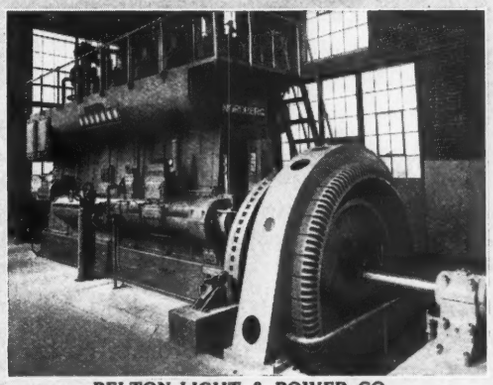
COMMUNITY PUBLIC SERVICE CO.,
Pecos, Texas
Three units — 4,900 H.P.



FLORIDA LIGHT & POWER CO.,
Punta Gorda, Fla.
Two units — 4,500 H.P.

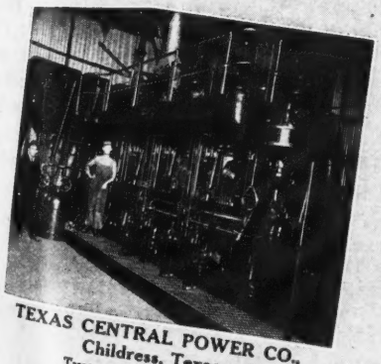


ISLAND GAS & ELECTRIC CO.,
Port-Au-Prince, Haiti
One unit — 1,500 H.P.

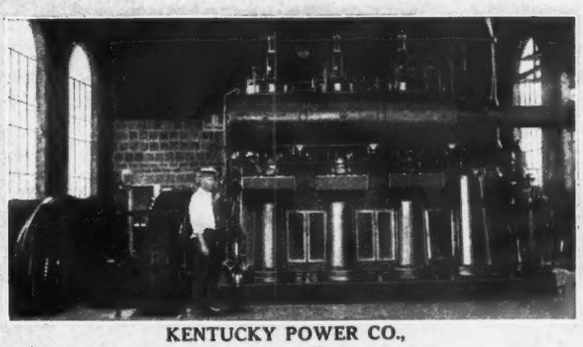


BELTON LIGHT & POWER CO.,
Belton, S. C.
One unit — 1,250 H.P.

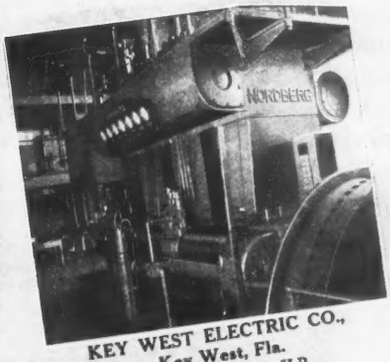
NEW MEXICO ELECTRIC SERVICE CO.,
Hobbs, New Mexico
One unit — 1,320 H.P.



TEXAS CENTRAL POWER CO.,
Childress, Texas
Two units — 880 H.P.



KENTUCKY POWER CO.,
Augusta, Ky.
One unit — 330 H.P.



KEY WEST ELECTRIC CO.,
Key West, Fla.
One unit — 750 H.P.

NORDBERG MFG. CO., MILWAUKEE

NEW YORK WASHINGTON CLEVELAND KANSAS CITY DALLAS LOS ANGELES

"ACCURATE REGULATION OF STEAM TO ATOMIZING BURNERS *means* MONEY SAVING"

*Case No. 319

STRAIGHT LINE FLOW ELIMINATES TURBULENCE . . .

Gets

HIGHEST VALVE CAPACITY

From inlet to outlet the fluid flows through this valve in a straight line — a streamline — almost as though there were a pipe running through the valve housing for the fluid to flow through. There is no detour around a dividing wall—the direction of flow is not changed at right angles because of a seat wall — also, the flow is not broken up by valve stems, springs, or other parts. The net result is NO TURBULENCE, hence MORE CAPACITY.

CASH STANDARD *Streamlined*

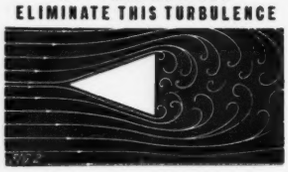
TYPE 1000 PRESSURE

REDUCING VALVE

. . . GIVES YOU UNUSUAL EFFICIENCY PROVIDED BY THE STRAIGHT LINE FLOW OF AIR-STEAM-WATER-OIL AND OTHER LIQUIDS AND GASES THROUGH THE VALVE

SHOWING HOW THIS VALVE INCREASES PERFORMANCE RESULTS BY ELIMINATING TURBULENCE . . .

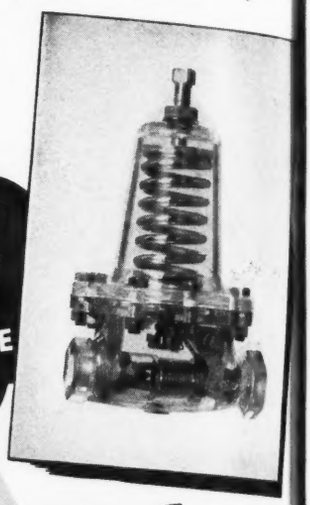
. . . . AND HOW YOU ELIMINATE THIS TURBULENCE



Because of the streamlined flow, you are easily able to meet peak demand and yet hold the pressure constant at the same time. You get abundant flow when you need it most. No turbulence is set up and therefore operation is smoother—you have no pressure variation—you have constant, dependable action—you experience no spoilage results due to turbulence.

* "Regarding your Streamlined Valves, we use them for atomizing steam to our burners. Correct atomization means money saving. We need the lowest possible friction loss (pressure drop) through the valve that is possible. We need highest capacity possible on low pressure difference across the valve. We need constant delivery pressure from the valve regardless of changes in demand on the valve. Your Streamlined Valves give us these qualities better than any other make we have used. And it may interest you to know that we have found that we can count on your Capacity Charts too."

A *Winner* WINS FIRST PRIZE



Statements from Streamlined (Type 1000) Valve users have come to us from all parts of the country—these verify the fact that this modern Streamlined Valve has no complicated parts to get out of order—no small ports or passages to clog up—nothing to keep it from working dependably—that you are easily able to meet peak demand and yet hold the pressure constant at the same time—that you really get high capacity flow when you need it most.

For example Case No. 305 says: "We are getting a better and more uniform product because our processing equipment is functioning better than ever before due to the even control the '1000' Valve is giving us. We also like the large capacity it is giving us."

Case No. 318 says: "Yes Sir! It's easy to say nice things about your Streamlined Valves. We like them very much. They have a whale of a lot of capacity. They control the reduced pressure within exceptionally close limits. They require NO maintenance—and I do mean 'NO!'."

The high pressure entirely confined to the small inlet chamber (cross hatched section) makes this valve good for initial pressures up to 3,000 lbs. The valve is furnished in sizes from ¼" x ¼" up to 2" x 2½" inclusive. For delivery pressures below atmosphere, a special diaphragm spring arrangement is used

SEND FOR BULLETIN 1000

PHOTOGRAPH SENT *Free*

Recently we had a Streamlined Valve made of crystal clear plastic (pictured above) as a display piece for our plant.

The fabricator made a duplicate for himself and entered it in MODERN PLASTIC Magazine's Annual Contest.

First prize in the Industrial Parts, Moulded Group was awarded the plastic Streamlined Valve by MODERN PLASTIC Magazine.

We had a few photographic prints made of the Crystal Clear Streamlined Valve on display in our plant. Each of our representatives was given one. These men have found that the picture proved interesting to people they called upon because the entire simple and efficient construction of the Streamlined 1000 Valve is seen.

You may find it interesting to have one of these photos so that you can see the construction that enables straight line flow—so you can see construction that eliminates complicated parts—and that insures, as users say, "lots of capacity and exceptionally close pressure control."

A photograph will be sent you upon request.

30-DAY TRIAL *Free* OFFER

Write for details on this special offer made to give you an opportunity to find new ways to save money

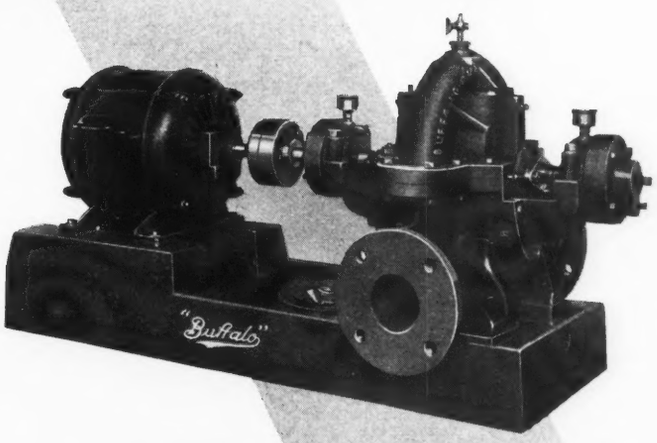
A. W. CASH COMPANY

DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

2 Great "Buffalo" PUMPS That Spell

ECONOMY



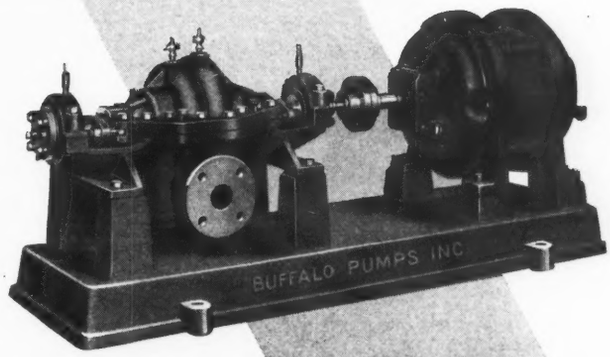
Double Suction, Single Stage Centrifugals

One of the finest, smoothest, double suction centrifugal pumps ever built. Thousands in service. Capacities from 10 to 50,000 G. P. M. Write for Bulletin 955.

EFFICIENCY

Type "RR" Single Suction Multi-Stage Centrifugals

Smooth, efficient, versatile. New design assures continuous hydraulic balance. None better for general service. Bulletin 980 gives full information.



BUFFALO PUMPS, INC.
488 BROADWAY BUFFALO, N. Y.
Branch Engineering Offices in Principal Cities.
Canada Pumps, Ltd., Kitchener, Ont.

DEPENDABILITY

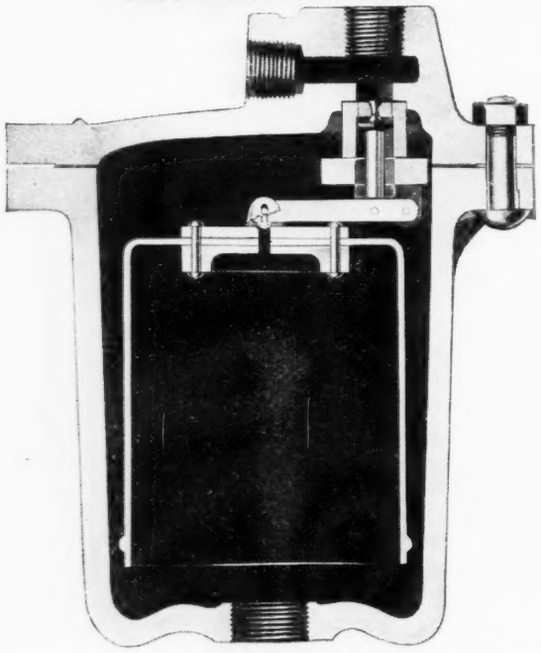
"Buffalo" PUMPS

used where Performance Counts

PIPEWRENCH PETE SAYS:

Here's Why STRONG Inverted Bucket Traps DON'T BALANCE!

Exclusive "Trigger" Vent Gives Sharp, Intermittent Action



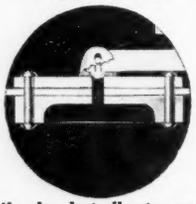
Saves on Production, Steam, Upkeep!

Now, STRONG gives you inverted bucket traps with an exclusive "trigger" action vent that ends balancing once and for all!

Full, intermittent operation, plus Anum-Metl seats and discs, plus wear-proof parts permit us to guarantee STRONG traps a full year against leakage or wear.

Write for your copy of catalog 63-P12 today!

Here's The STRONG "Trigger" Vent!



While bucket floats, valve almost closes vent. As bucket fills and reaches point of discharge, it starts to sink, removing valve from vent. This allows large quantity of air to escape suddenly, and causes bucket to sink to the bottom. Assures full, intermittent action.

The Strong, Carlisle & Hammond Co.
1392 West Third St., Cleveland, O.

STRONG
STEAM SPECIALTIES

Are you equipped to hold your job?—to get a new one?

The men who are keeping their jobs today—who are not feeling the whip of competition—are those who have kept one jump ahead of their jobs. They are the men who are equipped with a thorough-going and growing knowledge of the business they are in.

It works in the power plant field as well as in any other. Some men fit themselves to do a little more than their job calls for. They fit themselves to do a little more than the other fellow. They make a steady effort to equip themselves with the best kind of job insurance there is—KNOWLEDGE.

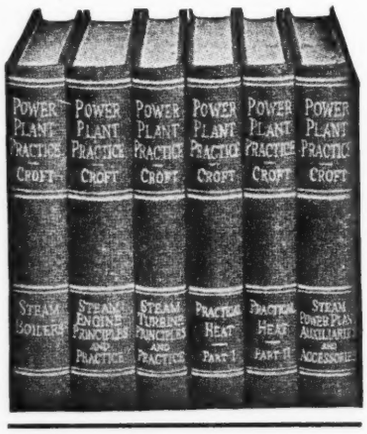
How about you? Do you know how quickly knowledge will pile up—how quickly you will become more valuable—if you spend a few minutes a day, regularly, studying sound books like the McGraw-Hill Library of Power Plant Practice? Do you know how easily it can be managed, paying only a few cents a day, while you use the books?

Thousands of men have followed this plan to win advancement or to make their jobs safe. You can, too. Read about this Library and our Free Examination Offer. Then send the attached coupon to us today.

POWER PLANT PRACTICE

(6 volumes—2,477 pages, 2,404 illustrations)

The Library of Power Plant Practice is the standard of the power plant field. It is accurate—it is thorough—it is complete. It is the result of years of experience with power plant problems. The man who has it has the best. The Library covers the whole field—nothing is omitted. The solution of every problem is plainly worded or explained with a clear illustration. The little stickers and the big troublesome problems are all worked out in advance for you. There can be only one result from studying these books a few minutes each day—more money in your pocket.



No books dealing with the work of the power plant man were ever so complete—so authoritative—so practical in text and illustrations as these. The man who puts this set of books into his library can do so knowing that he has the utmost in power plant books—a set that will give him, in language he can understand, all the information he needs in order to get ahead in his work.

Easy to Understand

These books are written in everyday easy-to-understand language. They are written to help the man on the job. It is just as if the author were working in the plant by your side and giving you the benefit of his vast knowledge, man to man. There is no bunkum in this Library, nor is it cluttered up with impractical theories. It is a **Power Plant Library** FOR POWER PLANT MEN.

Glance at the titles of the books in the photograph. They will give you an idea of how completely this Library covers **Power Plant Practice.** Here you have all the information necessary to make you indispensable on the job.

See it 10 days—Send no money

Fill in and mail the coupon below and we will send you the six volumes of the Power Plant Library for 10-days' Examination. If you decide to keep the books after examining them, just send $2.00 and then $2.00 a month until the total low price of $16.00 has been paid. See the coupon below for details. Send it Now and HOLD THAT JOB!

McGRAW-HILL ON-APPROVAL COUPON

McGRAW-HILL BOOK CO., INC., 330 West 42nd St., New York
Ship to me, charges prepaid, the six volumes of the **Library of Power Plant Practice.** If satisfactory, I will send $2.00 in ten days and $2.00 a month until the price of $16.00 has been paid. If not wanted I will return the set to you postpaid.

Name .....

Home Address .....

City and State .....

Firm or Employer .....

Position .....P. 12-39

(Books sent on approval in U. S. and Canada only)

How Long Since You Checked on RECORDING THERMOMETERS?

Today's conditions call for a new review of the profit-insurance possibilities of these simpler, surer, *mono-therm* instruments.

Was your last analysis of the possibilities for saving money with Recording Thermometers made back in the days when capital outlays were "out"? Did you decide to "let things ride for awhile," knowing that the addition of recording thermometers at one or more points would actually be a sound investment once profits were in sight again?

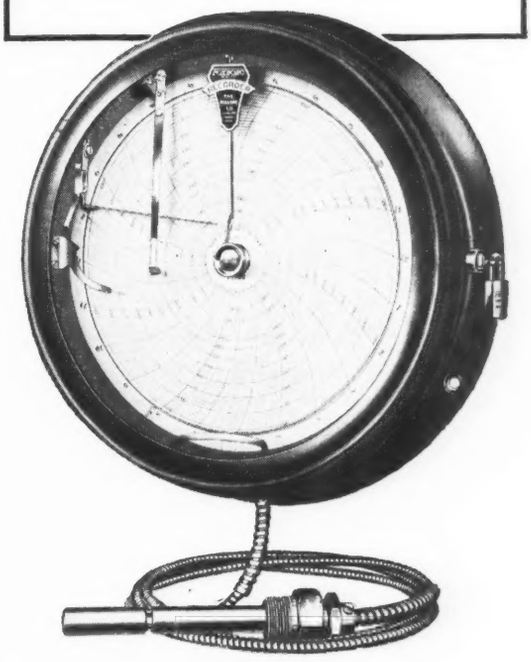
In that case, now's the time to recheck the situation in the light of rising costs of raw materials and the consequent higher costs of waste and operating delays. What's more, Foxboro's modern mono-therm system adds new factors of simplicity, surety and rapid response to the "go-ahead" side of the investment equation. You get the accurate records you need, day in and day out, without pampering or service expense. Today, on a unit-of-production basis, accurate temperature records are a cheaper form of profit-insurance than ever before!

Why not call in your superintendent and check over those trouble-spots that a few good, responsive Temperature Recorders might eliminate once and for all? The Foxboro man in your locality can suggest the particular type that will give you the records you want, and pay for itself most quickly out of its own savings. Or, if you wish, we'll mail you a 40-page bulletin, "Recording Thermometers," that gives facts and figures you're bound to need. Write for it today. **The Foxboro Company, 68 Neponset Avenue, Foxboro, Massachusetts, U. S. A.** Branch offices in 25 principal cities.

√ CHECK THESE APPLICATIONS

Recent orders for Foxboro Instruments have included Recording Thermometers for the following power plant applications:

- Air Preheater
- Boiler Room
- Coal Pulverizer
- Deaerator
- DeSuperheater
- Diesel Exhaust
- Economizer
- Feed Water
- Flue Gas
- Fuel Line (natural gas)
- Fuel Oil
- Fuel Storage Tank
- Generator Air Cooler
- Refrigeration Unit
- Steam
- Transformer Bank



FOXBORO

REG. U. S. PAT. OFF.

RECORDING · CONTROLLING · INDICATING

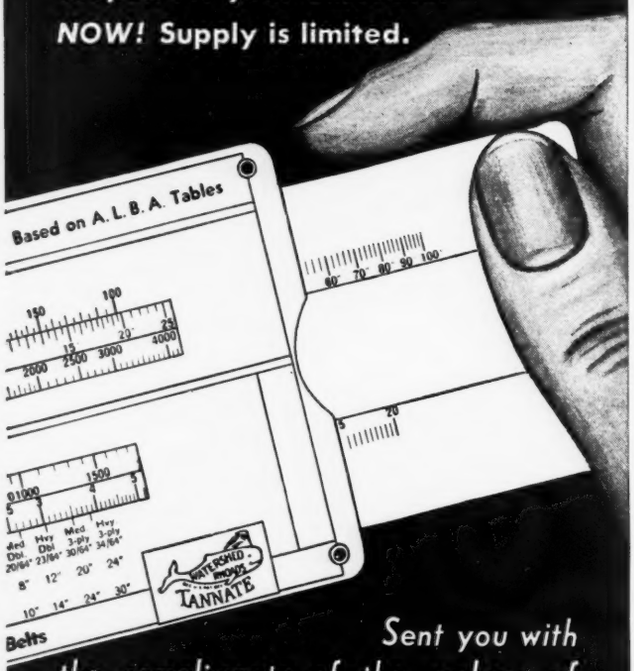
Certified ACCURACY with RESPONSE

Instruments

TEMPERATURE · LIQUID LEVEL
PRESSURE · FLOW · HUMIDITY

FREE
TIME SAVER

Calculates Belt Speed . . . HP per Inch of Belt Width . . . Belt Width swiftly, easily! It is pocket size—convenient to carry as it is to use. Engineers and Maintenance Men will find it handy as an extra arm, useful as a second brain. Mail the coupon for your Calculator—*NOW!* Supply is limited.



Sent you with the compliments of the makers of

RHOADS TANNATE LEATHER BELTING

JUST FILL IN AND MAIL THIS COUPON!

J. E. RHOADS & SONS • 35 North Sixth St., Philadelphia, Pa.

• *Please send a Leather Belting Calculator to*

NAME..... TITLE.....

COMPANY.....

ADDRESS.....

P. 12-39

BROWNELL

• Manufacturers of underfeed stokers for homes, apartments, churches, factories, schools and any power, processing or heating plant requiring stokers up to 500 HP with single retort. Larger sizes with twin retorts.

Write for Illustrated Bulletin

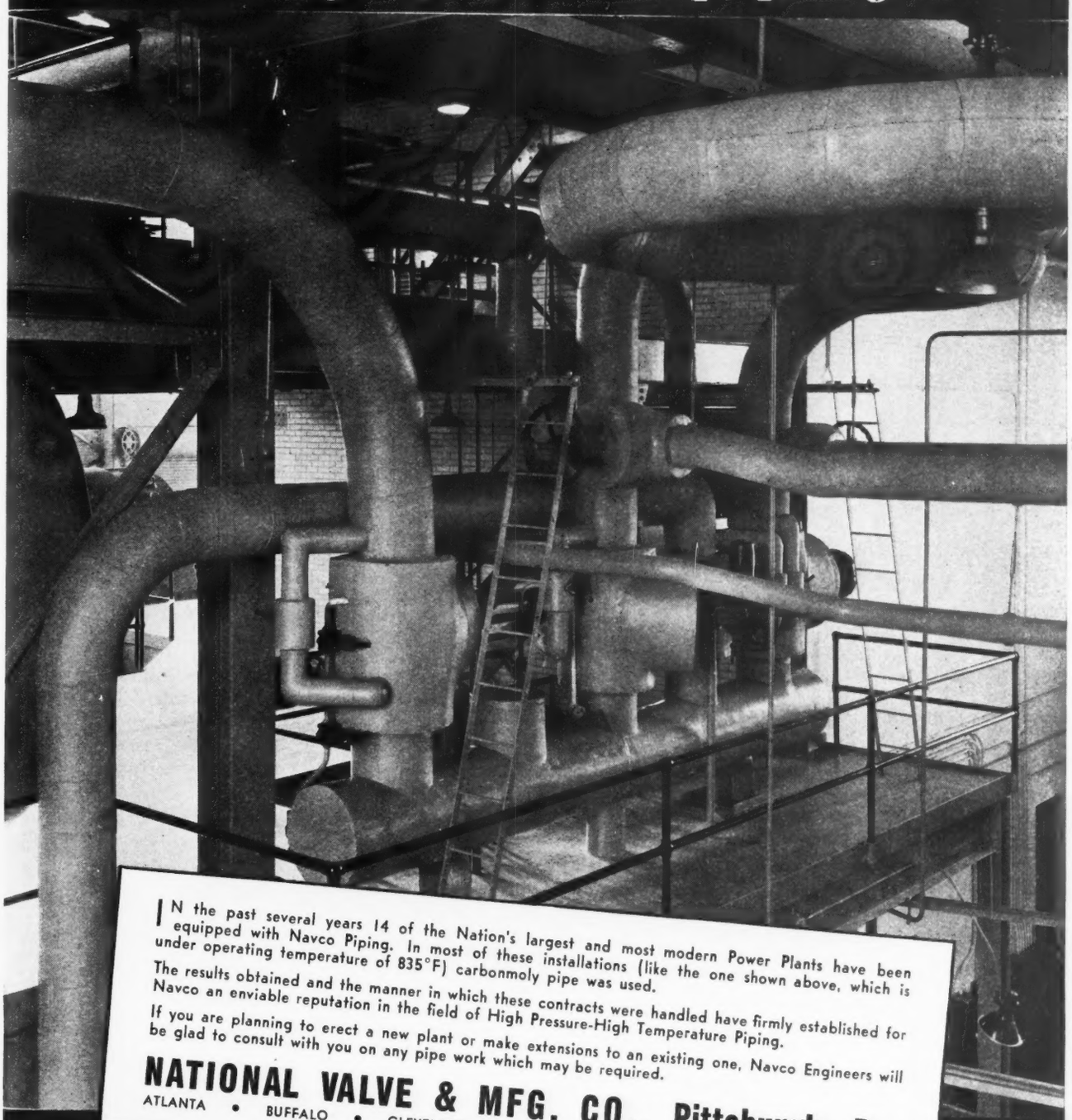
THE BROWNELL COMPANY — The World Over — SINCE 1855 — DAYTON, OHIO, U.S.A.

STOKERS

Every feature the careful buyer seeks in fittings will be found in the JARECKI line—the perfected product of 87 years' experience. Extra strength . . . accurate threads . . . types and sizes to meet every requirement. Distributors in principal cities.

Jarecki Manufacturing Co., Erie, Pa., U. S. A.

It's NAVCO *high pressure piping...*



IN the past several years 14 of the Nation's largest and most modern Power Plants have been equipped with Navco Piping. In most of these installations (like the one shown above, which is under operating temperature of 835°F) carbonmoly pipe was used.

The results obtained and the manner in which these contracts were handled have firmly established for Navco an enviable reputation in the field of High Pressure-High Temperature Piping.

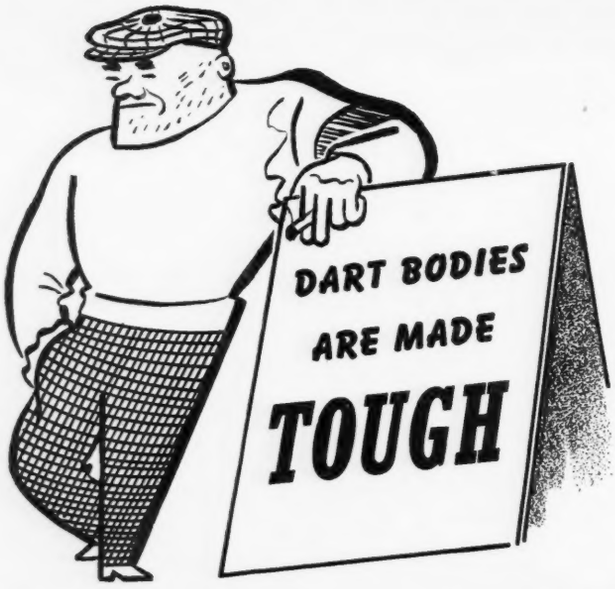
If you are planning to erect a new plant or make extensions to an existing one, Navco Engineers will be glad to consult with you on any pipe work which may be required.

NATIONAL VALVE & MFG. CO., Pittsburgh, Pa.

ATLANTA • BUFFALO • CLEVELAND • CHICAGO • NEW YORK • PHILADELPHIA

NAVCO PIPING

NAVCO



There are plenty of sound reasons for Dart's ability to "take it" in tough service. Dart bodies and nuts, for example, are made from high test, air furnace malleable iron, carefully selected for its resistance to stretch and distortion. This means extra resistance to pipe strains, prevents scored threads, insures tight joints *repeatedly* . . . So when operating conditions are tough, standardize on Darts. Send for one to try.

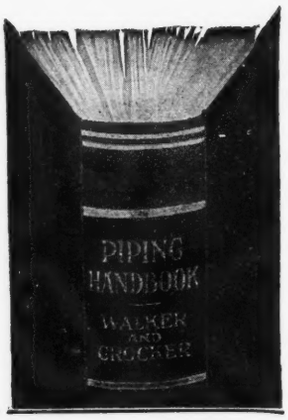
DART UNIONS

E. M. DART MFG. CO., Providence, R. I.

Sales Agents: The Fairbanks Company, New York, and all branches

Canadian Factory: Dart Union Company, Ltd., Toronto, Canada

New books to help YOU every day



Walker & Crocker's Piping Handbook

By J. H. Walker & Sabin Crocker, Detroit Edison Co.

3rd edition, 897 pages, 255 tables, $6.00

Problems of steam and power plant piping, heating and plumbing systems, oil and gas piping, etc.—all industrial applications are discussed and practical methods of solution indicated. Covers construction details, cost estimating, dimensional standards, material specifications, analysis of elastic properties of straight pipe and bends, tables, definitions, charts, formulas, etc.

Morrison's American Diesel Engines

By L. H. Morrison, Editor, *Diesel Power*

2nd edition, 482 pages, $5.00

A comprehensive manual, up-to-date, to help factory executives and operating engineers choose the diesel engine best suited to their purposes and tell them how to get the most out of it. Points out advantages in diesel power for industrial applications, describes American made engines in detail, gives practical, up-to-the minute information on testing, installation, and operation.

Lichty's Internal Combustion Engines

By Professor L. C. Lichty, Yale

5th edition, 603 pages, 397 illustrations, $4.50

Well-balanced treatment of theory, analysis and design. Very little descriptive material is given; treatment is fundamental and can be applied to all types of engines. Many illustrative examples are included. The present edition has been thoroughly revised and much new material added.

Clower's Lubricants and Lubrication

By James I. Clower, Va. Polytechnic Institute

464 pages, 332 illustrations, $5.00

Practical manual, for all concerned with buying, selling, or application of lubrications—how best to select and use them for specific purposes. Covers all necessary fundamentals—types, sources, and properties of lubricants, lubrication systems, fundamentals of lubrication, etc.—with six chapters on definite methods of selecting and using lubricants.

McGRAW-HILL ON-APPROVAL COUPON

McGraw-Hill Book Co., Inc., 330 W. 42nd St., N. Y. C.

Send me for 10 days' examination, subject to approval or return.
....Morrison—American Diesel Engines, $5.00
....Lichty—Internal Combustion Engines, $4.50
....Walker and Crocker—Piping Handbook, $6.00
....Clower—Lubricants and Lubrication, $5.00

At the end of 10 days I agree to remit for books plus a few cents postage or return them postpaid. (We pay postage on orders accompanied by remittance.)

Name .....

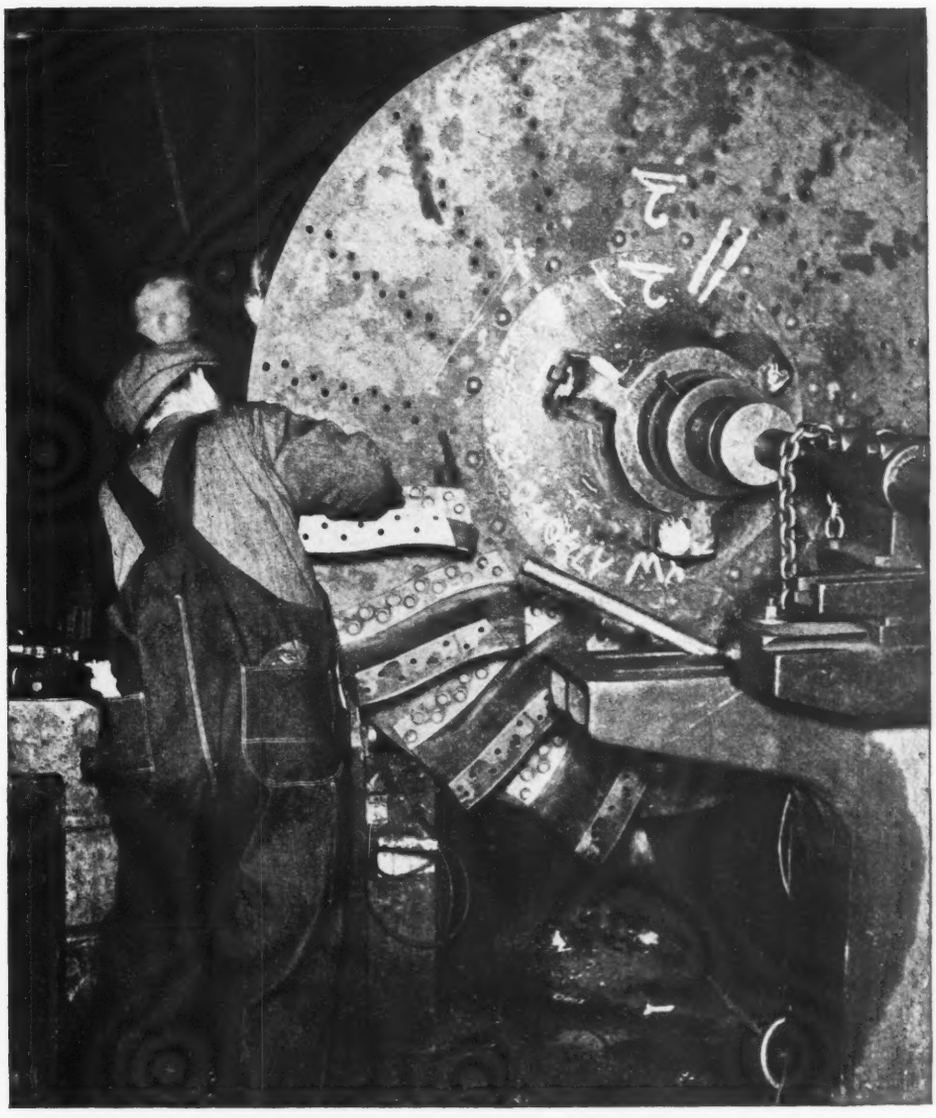
Address .....

City and State .....

Position .....

Company .....P. 12-39

(Books sent on approval in U. S. and Canada only.)



This Man is NOT on a Production Line

He and his partner are hot-riveting the blades on an Induced Draft Fan rotor. When it is finished, it will be installed where heat, abrasion, erosion—the combined forces of a man-made inferno—will attempt to destroy it.

Buffalo engineers found out years ago that in order to KEEP these fans ON THE JOB, they must be rugged. Heavy, solid centerplate, tapered solid side flanges, cut from a single plate, practically straight blades (no pocket to accumulate dirt) curved slightly backward at the tip and forward at the heel to better the efficiency. Blades have welded ridges or beads along the face of the blade to reduce abrasion. Tough, stiff, solid, the finished rotor is balanced perfectly. Installed on the job—it will operate without repairs far beyond the accustomed life for such fans.

A new booklet on "Buffalo" Induced Draft Fans will be sent on request.

"Buffalo"

BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, N. Y.

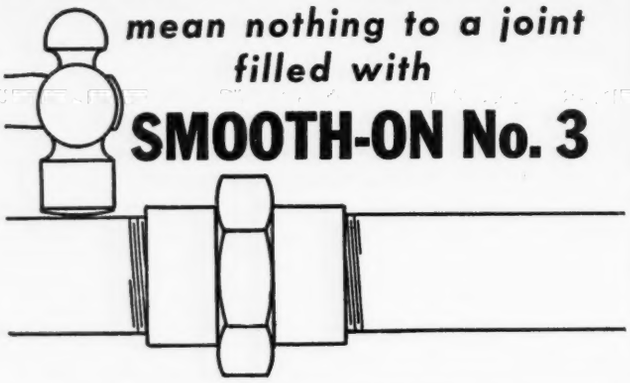
Branch Engineering Offices in Principal Cities
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Forced and Induced DRAFT FANS

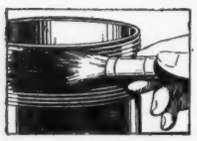
BLOWS and VIBRATION

mean nothing to a joint filled with

SMOOTH-ON No. 3



VIBRATION comes from the equivalent of constantly repeated hammer blows that with modern pressures, high superheat, etc., make the work of line and connecting joints more difficult than ever, but — joints filled with Smooth-On No. 3 can take this punishment.



Smooth-On No. 3 comes ready for use. Just paint it onto the threads.

A thread filling or gasket coating of Smooth-On No. 3 is merely filling the threaded joints or covering the gasket surface with a metallic iron which will solidify and hold the joint tight, beyond the possibility of any movement short of intentional disassembling. The initial and continued wedging action of the filling together with permanent freedom from chemical and physical disintegration makes the whole joint assembly virtually one solid mass — impervious to all that adjacent metal can stand.

Joints made with Smooth-On No. 3 may cost a cent or two more for the filling material, but stay off the trouble list for life, or in other words, involve no further labor expense. As labor is the big item here, ten joints made with Smooth-On No. 3 may cost far less in the long run than one joint made without this dependable material.

To make a good emergency gasket, cut cardboard, manila paper or wire gauge to size and coat with Smooth-On No. 3.

Because of its wide application and the quick, simple, reliable and permanent repairs it will make, Smooth-On No. 3 can and should be used extensively in every plant. A fair test costs almost nothing and would soon earn your confidence.

Buy Smooth-On No. 3 in 1 or 5-lb. can or 25-lb. keg from your supply house or if necessary direct from us.

Mail this coupon for the free SMOOTH-ON HANDBOOK

SMOOTH-ON MFG. CO., Dept. 30,
570 Communipaw Ave.,
Jersey City, N. J.

Please send SMOOTH-ON HANDBOOK.

Name .....

Address .....

.....

12-39 .....

Do it with SMOOTH-ON

Specify

AIR-MAZE AIR FILTERS

Eliminate Replacement Costs with these Permanent Panels

First cost is the last cost. Servicing is simple because the patented filter element permits quick **complete** cleaning. 99.83% efficient. Cannot clog. Unusually long operating periods between servicing. Write today for bulletins GPB-97 and IND-118.

Pat.

Open End View

FOR AIR COMPRESSORS, AIR - CONDITIONING SYSTEMS, POWER PLANTS, AND OTHER AIR-USING UNITS.

AIR-MAZE CORP., 5120 Harvard Ave., Cleveland, O.

AIR FILTERS FOR EVERY INDUSTRIAL APPLICATION

PEALE, PEACOCK & KERR

Graybar Bldg
NEW YORK

Broad St. Station Bldg.
PHILADELPHIA

AIR CLEANED

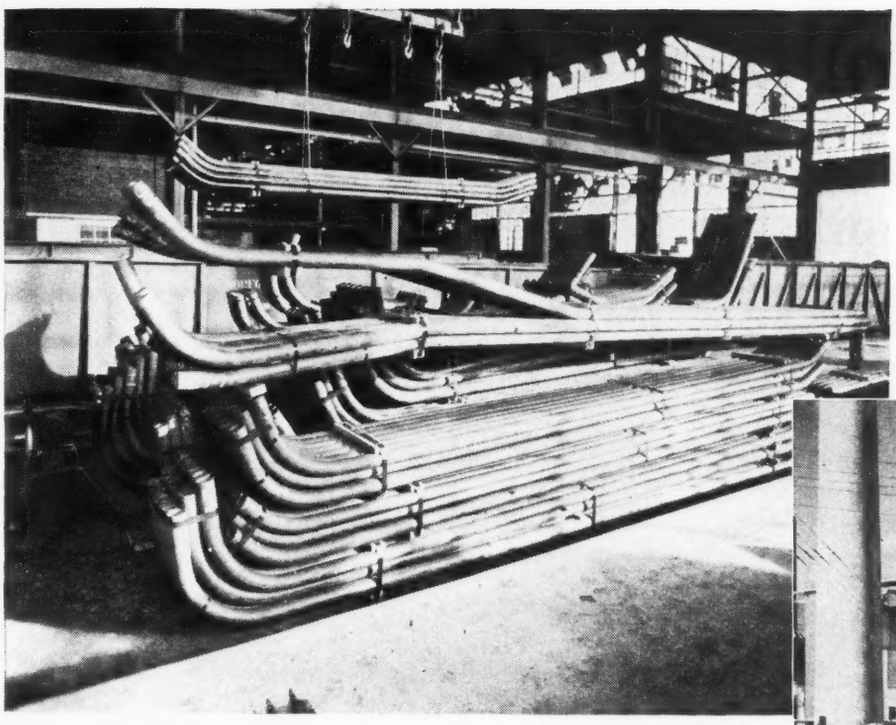
BITUMINOUS VICTOR COAL

ALL SIZES

Produced by us in the heart of Central Pennsylvania's field, low and medium volatile, and of uniform and dependable quality.

Our Fuel Service Engineers are at your call. They are qualified to aid you in getting the utmost in satisfaction, efficiency and economy from your equipment and the specific conditions under which it operates.

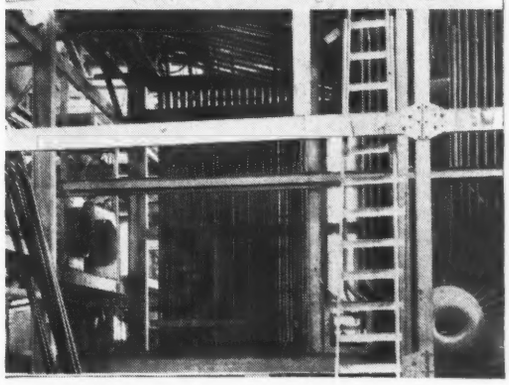
Standard Quality Anthracite



NORTHERN QUALITY

MEANS ECONOMY

NORTHERN PAPER MILLS
GREEN BAY, WISCONSIN



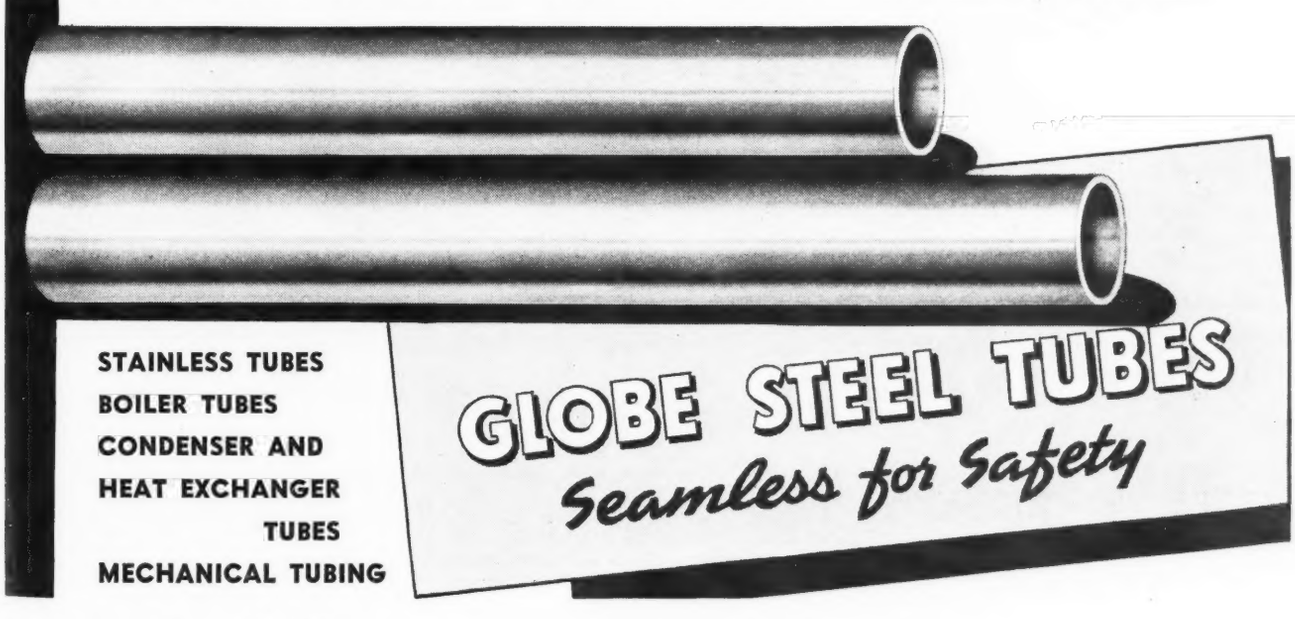
Handling Costs Cut At NORTHERN PAPER MILLS By Globe Group-Bundling

SUBSTANTIAL savings in tube-handling time and costs were reported by engineers in charge of the construction of the recently completed power plant of the Northern Paper Mills, Green Bay, Wisconsin.

As shown in the top illustration, all Globe tubes of the same contour are sorted, grouped, and bundled at the Globe plant before shipment. This pre-sorting avoids mixing of different contour tubes—re-bending—and provides greater speed and convenience in handling and erection . . . Northern Paper Mills is another modern power plant attesting the greater value, safety, and strength of Globe Seamless Tubes.

TOP: Exterior of Northern Paper Mills Power Plant, Green Bay, Wis. . . . LOWER: Globe Seamless Tubes being assembled in place.

GLOBE STEEL TUBES CO. • 4050 W. Burnham St., *Milwaukee, Wis.*



Your

EXCESS PRESSURE WILL NEVER VARY

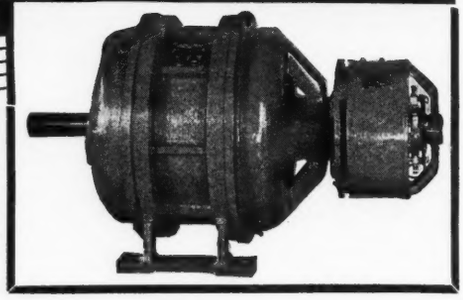
FULTON Boiler-Feed PUMP GOVERNOR

Feed-line pressure will exceed boiler-pressure by exactly as much as you desire, at all times, if you install a C-F Boiler Feed Pump Governor. If little water is required, the governor will reduce the steam supply to the pump and speed will be lessened. If much water is required, the governor will increase the steam supply and the pump will be speeded up. Ask for Bulletin 1766, also information on "Vigilant" Feed Water Regulator and other steam specialties.

The CHAPLIN FULTON MFG. CO.

28-40 PENN AVE. CF PITTSBURGH, PA.

COLUMBIA A. C. GENERATORS



62.5 KVA, .8 power factor, 240 volt, 3 phase, 60 cycle, 1200 RPM. Columbia revolving field type A.C. Generator with direct connected exciter.

SIZES: 1 TO 300 KVA
SPEEDS: 1800, 1200, 900, 720, 600, 514, 450 R.P.M.
SHIPMENT: ONE WEEK TO 10 DAYS

Driven by Diesel or gas engine, Columbia Generators furnish power and light where current is not available and are also used for stand-by service in event of power failure. Compactly built, they are easily portable. Write for bulletin describing their dependable construction.

COLUMBIA ELECTRIC MFG. CO.
4519 HAMILTON AVE., CLEVELAND, OHIO

---

the Equivalent of Over 60,000 Miles on Your Automobile—

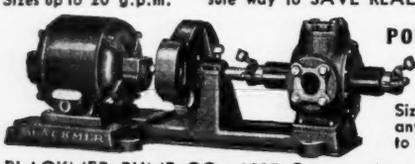
and NO CAPACITY LOSS!

15 Models

HAND PUMPS
for pumping from drums, barrels, etc. Easy to turn—fast acting—self-priming.
Sizes up to 20 g.p.m.

BLACKMER Rotary Pumps are trouble-free. We know that, because of the exacting tests we give them. Recently we ran a standard pump 2500 hours continuously at 1800 r.p.m.—equal in performance to over 60,000 miles on your automobile. Then, by actual measurement, we found NO CAPACITY LOSS.

Let us in on your next pumping problem. That's a sure way to SAVE REAL MONEY in overall cost!



POWER DRIVEN PUMPS
Ideal for pumping almost any liquid—acids, alkalies, chemicals, oils, foods, etc. Sizes from 20 to 700 g.p.m.—any type of drive. Pressures up to 75 pounds.

BLACKMER PUMP CO., 1925 Century Ave., Grand Rapids, Mich.

BLACKMER ROTARY PUMPS
AUTOMATIC TAKE-UP FOR WEAR
EXCLUSIVE BUCKET DESIGN

YOUR ANSWER *to Clogged Oil Cooler Tube Bundles*

Sludge-clogged oil cooler tube bundles that prevent proper heat transfer are effectively cleaned the low-cost Oakite way. No need to dismantle tube bundle. When a solution of the recommended Oakite material is circulated through unit, stubborn deposits of carbon and oil residue are removed in an unbelievably short time. Heat transfer efficiency is restored.

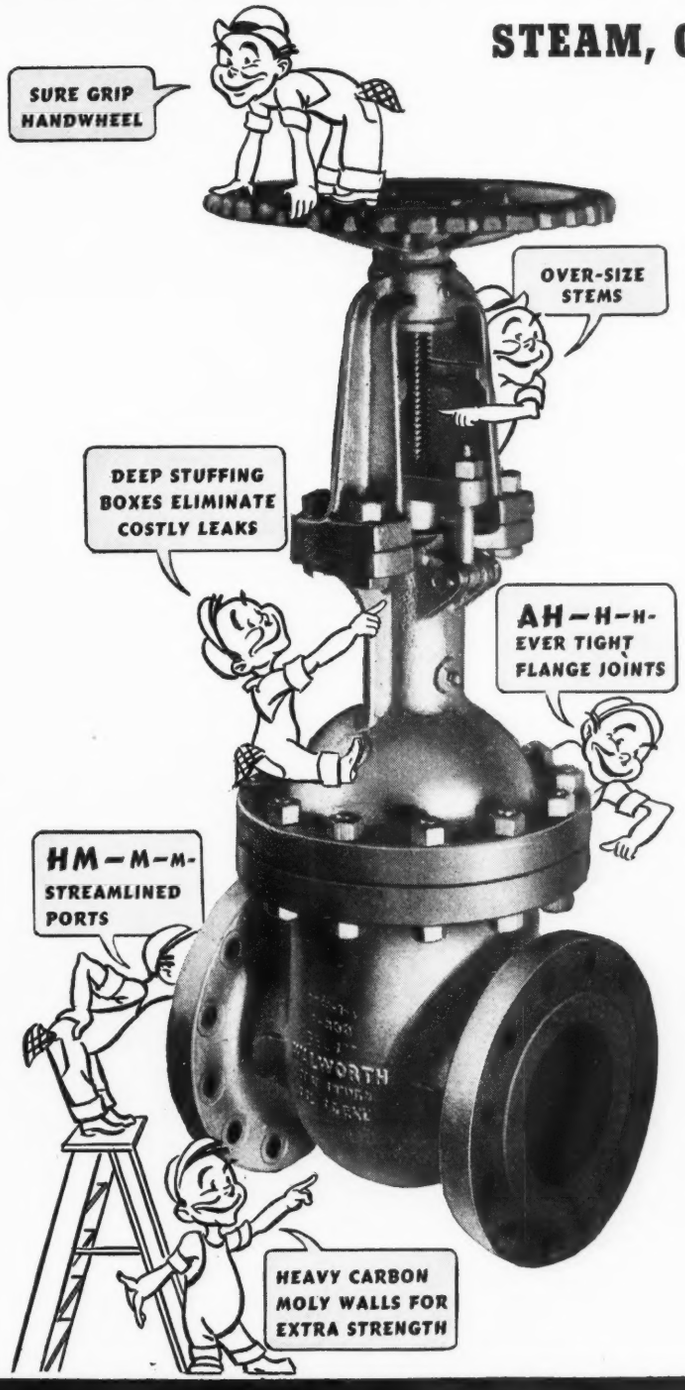
For further details on this, or on other heat exchange cleaning, paint stripping from transformers, cleaning Diesel water jackets, etc., write for a copy of new FREE booklet. No obligation.

Manufactured only by
OAKITE PRODUCTS, INC., 23 Thames St., New York
Representatives in All Principal Cities of the U. S.

OAKITE CERTIFIED CLEANING
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

STEEL VALVES

WALWORTH makes a *Complete* line for STEAM, OIL, WATER and GAS


SURE GRIP HANDWHEEL
OVER-SIZE STEMS
DEEP STUFFING BOXES ELIMINATE COSTLY LEAKS
AH—H—H- EVER TIGHT FLANGE JOINTS
HM—M—M- STREAMLINED PORTS
HEAVY CARBON MOLY WALLS FOR EXTRA STRENGTH

Walworth manufactures a complete line of cast steel valves in all types and trimmings and in a range of 150 — 1500 lbs. W.S.P. Oil, Water and Gas pressures up to 5000 lbs.

Unless otherwise ordered all parts of Walworth Steel Valves (and Walworth Steel Fittings) are made from carbon molybdenum steel conforming to A.S.T.M. Specification A-157 Grade C1. These valves are available with a variety of trims such as stainless steel, monel, stellite, etc.

The latest engineering features have been included in the design, metallurgy, and construction of these steel valves.

Oversize stems, deep stuffing boxes, streamlined ports, heavy carbon molybdenum walls and flange thicknesses calculated in accordance with the Waters and Associates' formula, make these valves tough, wear-resistant and dependable. Write for descriptive bulletin.

Whatever your valve-need — steel, bronze, or iron — Walworth has "the correct valve for any and every service." For information about the complete line of Valves, Fittings, Pipe and Tools, contact your nearest Walworth distributor.

Walworth's Complete Line includes:

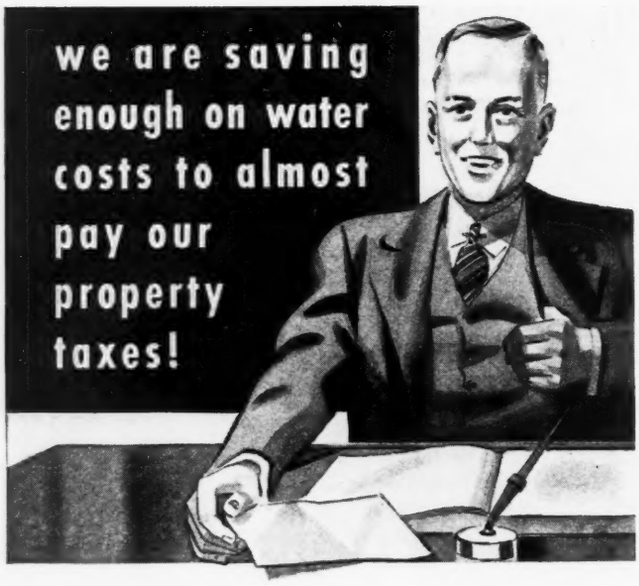
BRONZE VALVES AND COCKS—all types and pressures ★ IRON BODY VALVES AND COCKS — all types and pressures ★ STEEL VALVES — all types and trimmings. Pressures: 150—1500 lbs. Steam. Oil, Water and Gas up to 5000 lbs. ★ LUBRICATED PLUG VALVES—all metals and pressures ★ BRONZE FITTINGS—screwed and flanged ★ CAST IRON FITTINGS—screwed and flanged ★ MALLEABLE IRON FITTINGS—screwed ★ STEEL FITTINGS—screwed and flanged ★ CAST IRON THREADED PIPE — Hi-Test, C.N.I., Ni-Resist ★ SOIL PIPE AND FITTINGS ★ DRIVE WELL POINTS—Foot valves, etc. ★ PIPE WRENCHES — Genuine Stillson, Walco, Parmelee WALSEAL — bronze valves and fittings for making Brazweld joints.

WALWORTH

WALWORTH COMPANY
60 EAST 42nd STREET, NEW YORK

VALVES FITTINGS and TOOLS
Backed by 97 Years' Service

DISTRIBUTORS IN PRINCIPAL CITIES THROUGHOUT THE WORLD



42% REDUCTION IN COST OF WATER OBTAINED WITH DEMING *Water Lubricated* TURBINE PUMPS

High water rates and high property taxes were serious obstacles to profits for a midwestern manufacturer. Nothing could be done about taxes. But something was done about water rates.

A well driller determined there was water of proper analysis on the property. His recommendation to install a Deming Deep Well Turbine Pump was accepted. The installation was made two years ago.

An average annual net reduction of 42% was made on water costs . . . almost sufficient to pay the company's property tax!

If you have reason to believe that YOUR water costs are too high, let us help you investigate.

SEND FOR THIS FREE BULLETIN

. . . which illustrates and describes all features of Deming Water Lubricated Deep Well Turbine Pumps with illustrations of many installations.

DEMING

PUMPS AND WATER SYSTEMS

THE DEMING COMPANY • SALEM, OHIO

"It's the Best"

CHAMPION COAL

Regardless what type of boiler you operate or what kind of firing or fuel feed employed, there is a Champion Coal scientifically prepared for the purpose. This complete range of Champion Coal makes possible the one best type of coal for your exact needs, assures over-all combustion efficiency the year around.

Avail yourself of our combustion engineering service.

PITTSBURGH COAL COMPANY

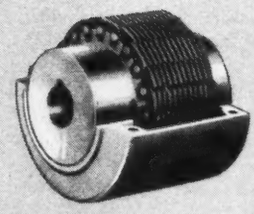
Oliver Bldg., Pittsburgh, Pa.

Baltimore, Md.; Cleveland, Ohio; Sault Ste. Marie, Mich.; Buffalo, N. Y.; Utica, N. Y.; New York City; Philadelphia, Pa.; Youngstown, Ohio.

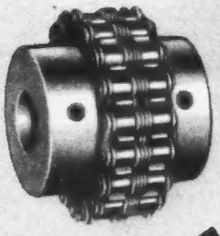
PITTSBURGH COAL CO. LTD., London, Ont.; Hamilton, Ont.; Toronto, Ont.; Windsor, Ont.

PITTSBURGH COAL COMPANY of Wisconsin, Duluth, Superior, Minneapolis, St. Paul.

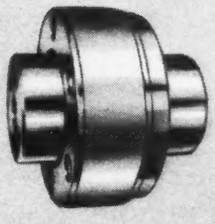
MILWAUKEE-WESTERN FUEL COMPANY, Milwaukee, Wisconsin.



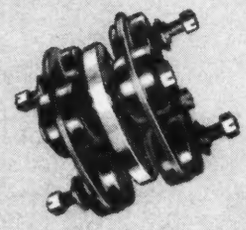
Silent
Chain Coupling



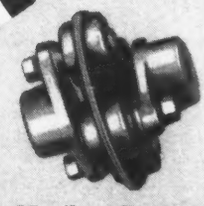
Roller Chain
Coupling



Morflex
Radial Coupling



Morflex Universal Coupling
Series CC



Morflex Coupling

MORSE COUPLINGS

There's one for every
DRIVING NEED

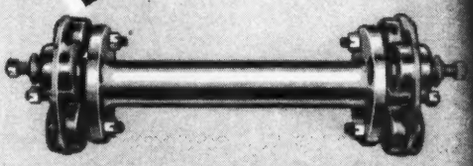
The Morse line of flexible couplings and universal drive shafts is complete. There's one that's *right* for every application.

Three types: Morse Chain couplings—facing steel sprockets wrapped in a length of special Morse coupling chain. Morse Morflex couplings—two steel hub members and a floating center, with connections made through solid rubber trunnion blocks. Morse Morflex Radial couplings—radially placed rubber trunnion blocks on the hub member eliminating all metal on metal movement. Morse Universal Drive Shafts utilize the strength and cushioning flexibility of the two Morflex types.

All Morse couplings and drive shafts are built to high standards of dependability, strength, long service, and high efficiency.

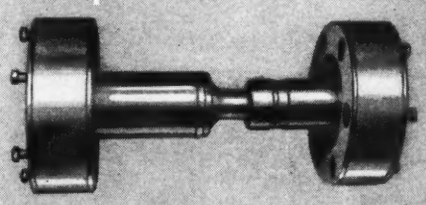
Just off the press! A new Morse Coupling Catalog—Bulletin 57—containing full information, installation and operating data. A copy of this valuable book is yours for the asking. Just write Morse, Ithaca, and ask for Bulletin 57.

MORSE CHAIN COMPANY, Ithaca, N. Y.



Morflex Universal Drive Shaft—Series T

Morflex Universal Drive Shaft
Long Coupled Series ST



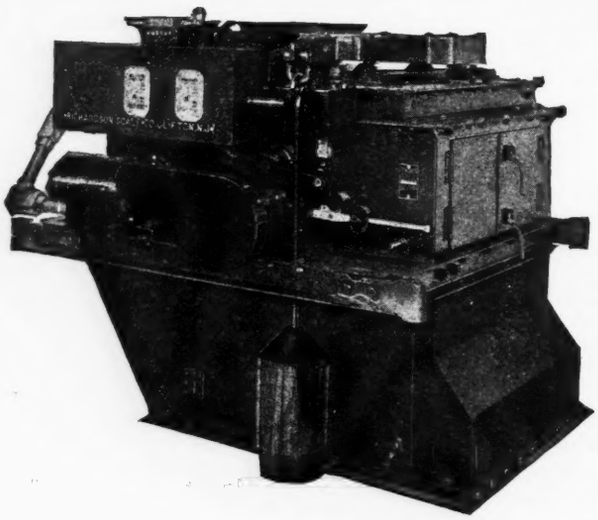
Morflex Radial Coupling Drive Shaft
Series RT Long Coupled

SILENT CHAINS ROLLER CHAINS FLEXIBLE COUPLINGS KELPO CLUTCHES

MORSE *positive* DRIVES

MORSE CHAIN COMPANY ITHACA N. Y. DIVISION BORG-WARNER CORP.

Increase BOILER EFFICIENCY *and lower* POWER COSTS *with the* RICHARDSON AUTOMATIC COAL SCALE



By comparing a month's coal bills with a month's output, you can *guess* at the power efficiency of your plant.

By estimating the day's coal consumption and comparing with the day's power sheets, you may "come pretty close". But in these days of high costs, a *guess* often represents the margin between profit and loss.

Richardson Automatic Coal Scales provide accurate and indispensable records for each boiler—each hour, shift, day, week and month—and assure highest possible operating economy.

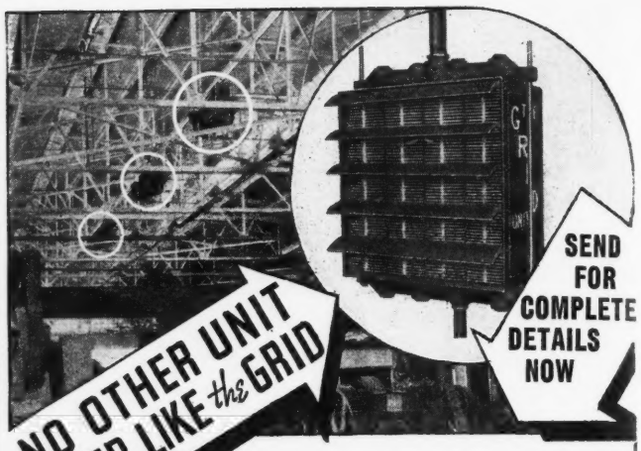
Your fuel bill is a major cost item. If one boiler produces only 9 lbs. of steam instead of 10 lbs., that's a 10% loss!

By having a constant record and check of coal burned, up to any minute you take a reading, you will know what each boiler is producing, and will know what to do to save coal by avoiding waste, increase boiler efficiency and decrease your steam costs.

RICHARDSON

Atlanta Chicago Montreal Philadelphia
Boston Columbus New York San Francisco
Minneapolis Omaha Wichita

RICHARDSON SCALE COMPANY, CLIFTON, N. J.



Here is a unit heater that will save you maintenance cost. The GRID is free from leaks and break downs, because it is not affected by electrolytic action. Heating sections are all-cast aluminum bonded to cast high-test iron steam chamber, in one piece in the casting process. It is a permanent piece of heating equipment, for either high or low steam pressures in various sizes and capacities to meet all requirements for suspended type heating. Complete details upon request.

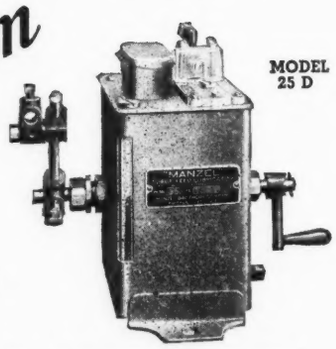
THE UNIT HEATER & COOLER CO.

Offices in all principal cities WAUSAU, WISCONSIN

GRID UNIT HEATER

MANZEL *FORCE FEED* LUBRICATORS

Reduce Lubrication Costs



ONE TO THIRTY FEEDS

You can save from $3 to $6 out of every $10 you spend for lubricating oil by replacing obsolete lubricating devices with Manzel Force Feed Lubricators. Manzel Lubricators feed any grade of oil, and will deliver any desired amount to cylinders or bearings in direct proportion to speed of engine.

Not affected by temperature or pressure. Save oil. Increase power. Prolong life of machinery.

Available with any required number of feeds, ratchet or rotary drive. Also furnished with two compartments for feeding two kinds of oil.

Write for catalog.

MANZEL BROTHERS COMPANY
326 Babcock Street Buffalo, N. Y.

One look at the heavy, husky body of these new Fairbanks Bronze Gate Valves, with reinforced ribs at the sides and bottom, and you will say "There's quality!"

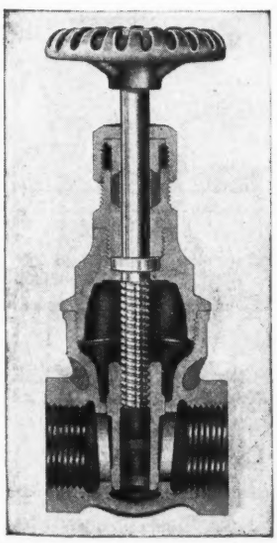
Quality is reflected in every one of the advanced, modern features that make these Fairbanks Valves such outstanding value.

All that Fairbanks has learned in more than 50 years of valve manufacturing has been incorporated in these

Fairbanks

New BRONZE GATE Valves

Larger, stronger pipe end Hexes . . . large bonnet Hex which projects over the bonnet threads . . . big clearance between end of threads and diaphragm . . . greater length of threads . . . reversible wedges . . . rib guides in body, and heavy internal ribbing in wedge, are but a few of the outstanding features. Similar evidences of quality are apparent throughout.

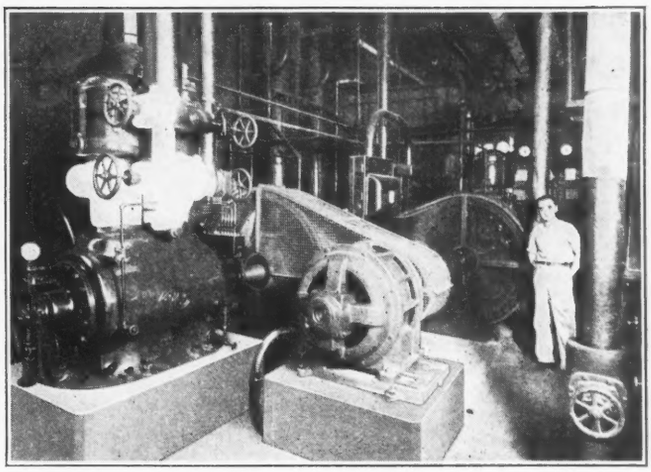


They're made in non-rising stem, with solid tapered wedge; and rising stem with slip-on solid or split wedge. Distributors everywhere stock these valves.

Write for our new booklet.

The Fairbanks Co.

397 LAFAYETTE ST.
NEW YORK, N. Y.
Boston, Pittsburgh—Distributors in Principal Cities
Factories:
Binghamton, N. Y. Rome, Ga.



Keep them going smoothly with

TRADE FRICK MARK

Registered U. S. Patent Office

Refrigerating Machine Oil

Made expressly for use with Ammonia and Freon-12. Fluid enough to spread properly over bearings, yet having body enough not to atomize. Has great film strength, yet will not gum on valves. Resists thinning out, but does not congeal in condensers or coils. Three weights, but only one superior grade: dry, pure, and with the highest lubricating value.

Frick Oil is Available in Cans and Drums through Frick Branches and Distributors in Principal Cities Everywhere.

Used by thousands of engineers who know good oil: standard for all Frick refrigerating machines because no other oil lubricates so well, lasts so long, keeps machines running so smoothly! Get full details: write

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA. U.S.A.

Clean Tubes FASTER for LESS MONEY

New valve permits one-man operation of tube cleaner

The new Roto gives you two big money-saving features. One-man operation saves the cost of a helper and eliminates delays caused by signalling. Increased power of new motor gives you far greater cleaning effectiveness. Full details without obligation. Write.

See Our Advertisement in Sweet's

The ROTO Company

145 Sussex Avenue Newark, N. J.

It is More Difficult than Ever to Export to Canada

Under normal conditions, the import charges on a shipment from the United States to Canada (Manufactures of steel and iron N.O.P.) exclusive of carrying charges, amount to 35% of the Canadian value of the American invoice, plus exchange.

Today, with the exchange pegged at 11%, it means that the import charges on American goods of this classification entering Canada amount to 49.85%, making it extremely difficult if not impossible to market American goods in Canada unless you have the advantages of a Canadian branch factory or are associated with a Canadian Company who have the necessary plant facilities to wholly or partially manufacture or assemble your products in Canada.

This company has had thirty-five years experience in the manufacture, assembly and sale of American goods in Canada, and we have the necessary plant, engineering and sales facilities.

If you are interested in serving the Canadian Market and through Canada to reach the markets of the British Empire, we will, without any obligation on your part, be very glad to discuss your problem with you.

The Arthur S. Leitch Co.
LIMITED
TORONTO CANADA

PROFESSIONAL SERVICES

Consulting Valuations Reports
Developments Appraisals Construction
Designing Testing Financing
Inspections Cost Analysis Investigations

OLIVER FIELD ALLEN
Licensed Professional Engineer New York State
Fellow: A.I.E.E. Member: A.S.M.E., S.A.E.
Am. Chem. Soc., Am. Mil. Engrs.
Consulting Engineer
Diesel Engines, International Engineering Liason
Gas and Oil Engine Power Applications
Regular Foreign Correspondent.
117 Liberty Street, New York City
Cable Address: OFALL-New York

J. H. MANNING & COMPANY
ENGINEERS
Business Studies, New Projects, Purchases-Sales, Management, Valuations, Reorganizations, Mergers, Public Utility Affair (including Integration)
120 Broadway New York
Field Building Chicago

JOHN A. STEVENS, Inc.
Established 1909
CONSULTING ENGINEERS
Power Plants Paper Mills
Dye Houses Surveys
Lowell, Massachusetts

HALL LABORATORIES, Inc.
R. E. Hall, Ph. D., Director
CONSULTANTS ON
BOILER WATER CONDITIONING
304 Ross St. Pittsburgh, Pa.

SARGENT & LUNDY
INCORPORATED
ENGINEERS
140 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS

STONE & WEBSTER ENGINEERING CORPORATION
Design and Construction
Reports • Examinations • Appraisals
Consulting Engineering
BOSTON • NEW YORK • CHICAGO
PITTSBURGH • SAN FRANCISCO • LOS ANGELES

D. W. HAERING & CO., Inc.
Consultants, Analysts and Manufacturers on Scale, Corrosion and Proportioning Problems
2308 S. Winchester Ave., Chicago, Ill.

FRANCIS J. SILL
HEAT and POWER ENGINEERING
as applied to Industrial Plants
Tests—Reports—Design—Construction
Westboro, Massachusetts

THE J. G. WHITE ENGINEERING CORPORATION
ENGINEERS—CONSTRUCTORS
Steam and Hydraulic Power Plant Design and Construction, Investigation and studies of Power and Steam Problems.
Reports and Appraisals
80 Broad St., New York

WHERE TO BUY

SUPPLEMENT

Featuring additional products and specialties for power plants

ONE INEXPENSIVE MODERN DEVICE • • • •

installed at a crucial spot can frequently remove the "bugs" from an entire process.

It's the faster and surer electrical and mechanical "helps" and "hazard removers" that reduce costs and save company money.

One product advertised on this page may be the answer to *your* problem . . . *a real money-saver for your company.*

To be informed—and reminded—on modern aids to efficient and economical plant operation, check "Where to Buy" Advertising regularly . . . *every issue.*

For additional information write Departmental Advertising Staff

POWER
330 West 42d St., New York City

How Much Does **Boiler Scale Cost You?**

•

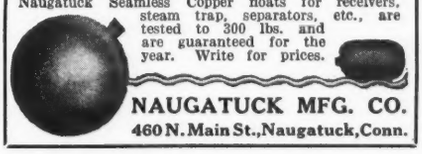
A scientific boiler treatment

.. **HAMILTON BOILER Treatment**

•

E. A. HAMILTON CO.
143 Peck Ave. Syracuse, N. Y.

SEAMLESS COPPER FLOATS THAT SAVE MONEY
Naugatuck Seamless Copper floats for receivers, steam trap, separators, etc., are tested to 300 lbs. and are guaranteed for the year. Write for prices.



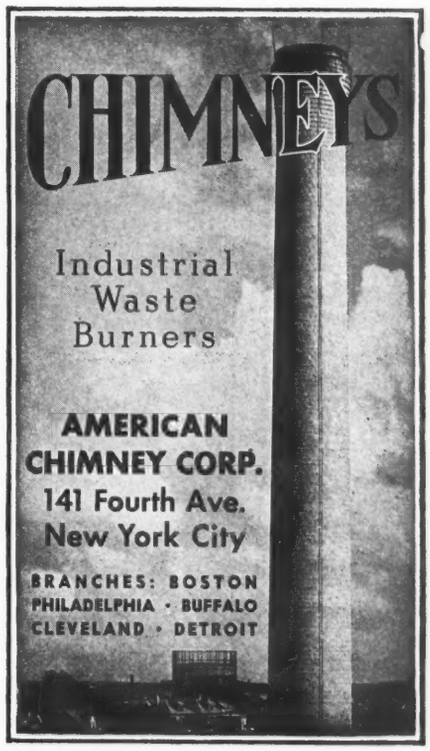
NAUGATUCK MFG. CO.
460 N. Main St., Naugatuck, Conn.

THE ORIGINAL
Tripp Metallic Packing
TRIPP METALLIC PACKING CO.
BOSTON MASS.

"MONO"
BOILER BAFFLES
HIGH TEMPERATURE REFRACTORY CEMENTS
SANFORD C. SMITH REFRACTORIES, INC.
1715 NIAGARA St., Buffalo, N. Y.

? *Find what you are looking for? If this or other advertising in this issue does not supply the information wanted, of products or services, write*

Power
330 West 42nd Street, New York City



NIAGARA TRANSFORMERS
Oil and Air Cooled
5 to 1000 K.V.A.
All Voltages and Cycles
We still have a few territories open for agents
ERIE ELECTRIC CO.
112 Church St. Buffalo, N. Y.

THE PURE

PURE THREE POINT LUBRICATION • A Complete Line of Industrial Petroleum Products

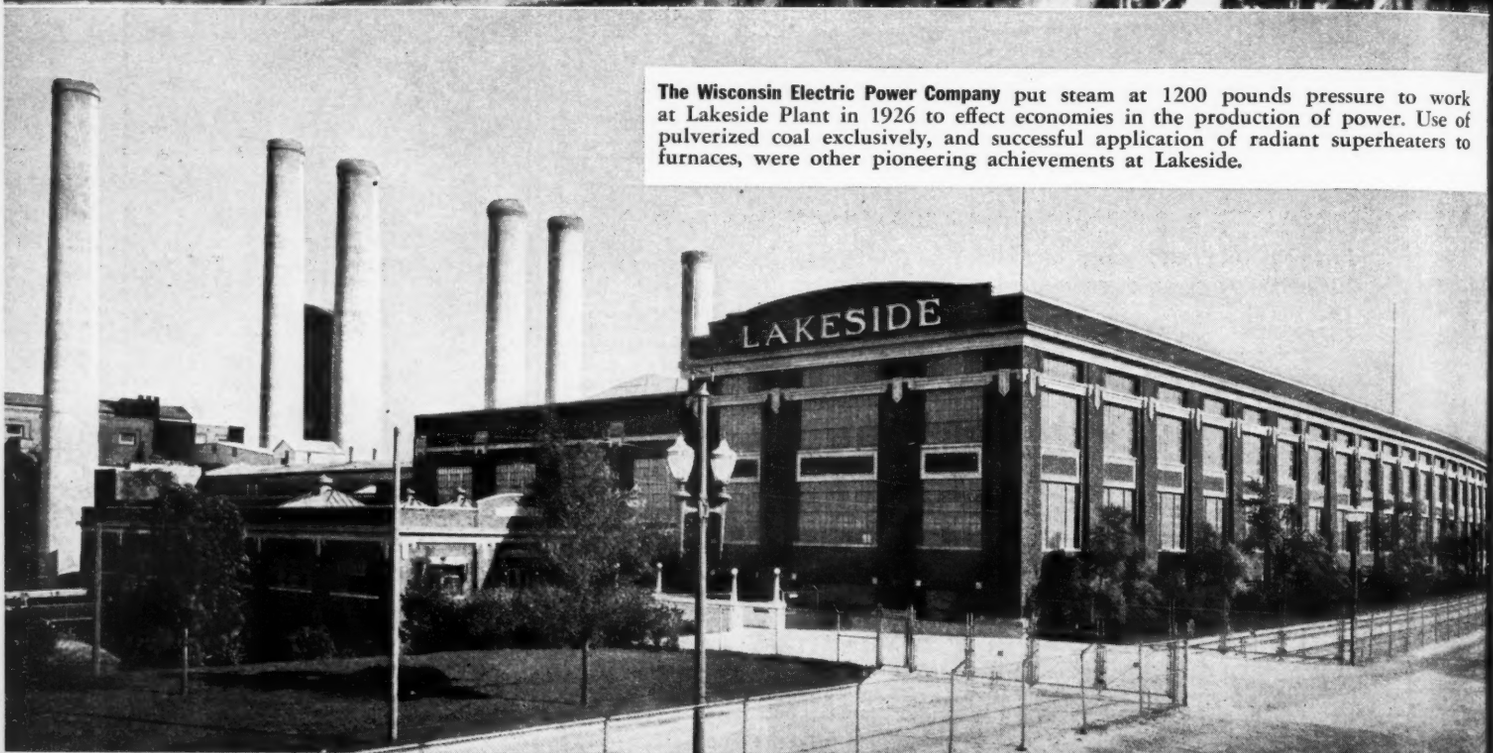
THE PURE OIL COMPANY, U.S.A. — PURE — THREE POINT SERVICE — LUBRICATING — INDUSTRIAL DEPT. APPLICATION — CRUDE

Ask a Pure Oil Engineer to help solve your lubrication problems

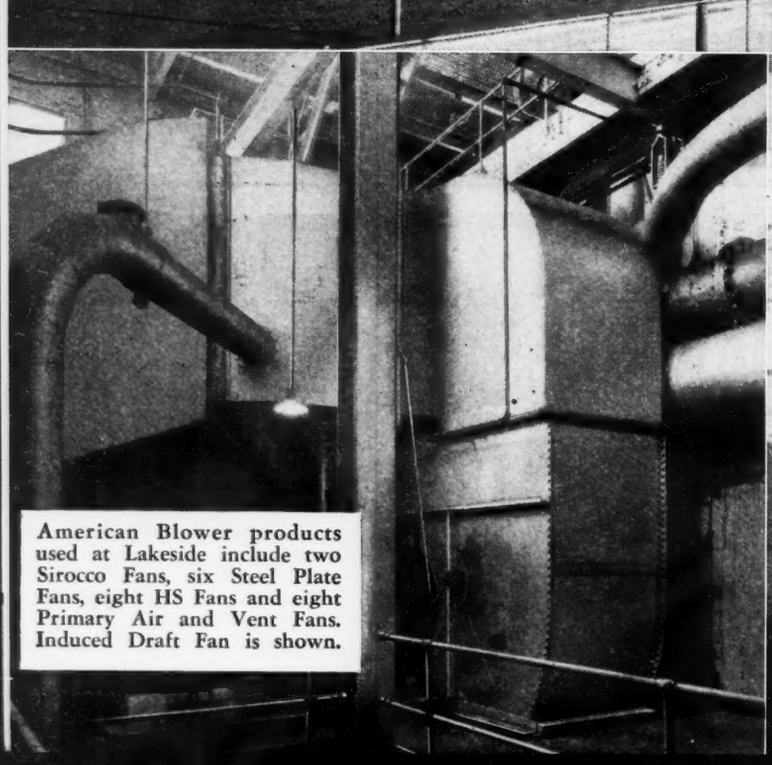
OIL CO.
CHICAGO, U.S.A.

MORE

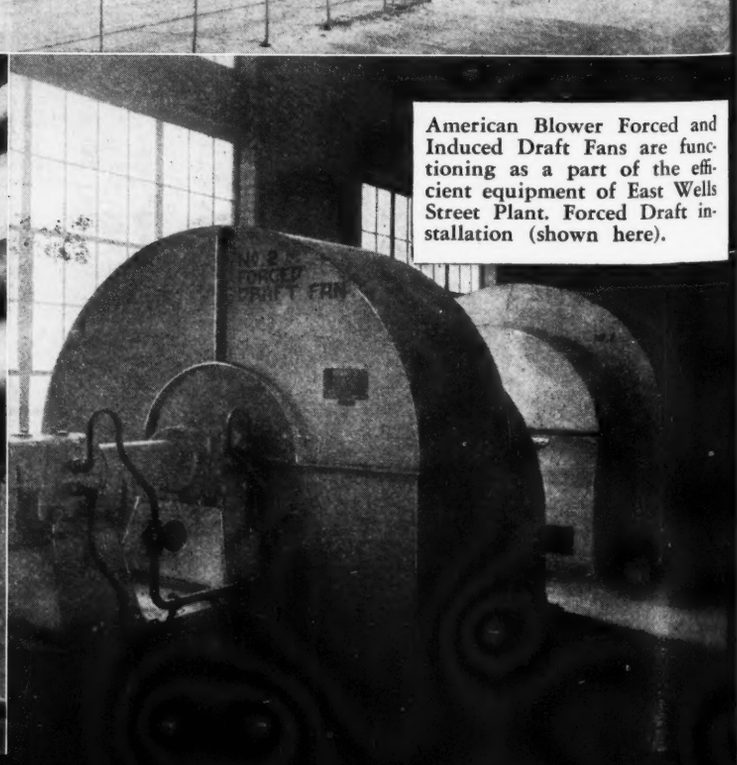
TO SERVE A



The Wisconsin Electric Power Company put steam at 1200 pounds pressure to work at Lakeside Plant in 1926 to effect economies in the production of power. Use of pulverized coal exclusively, and successful application of radiant superheaters to furnaces, were other pioneering achievements at Lakeside.

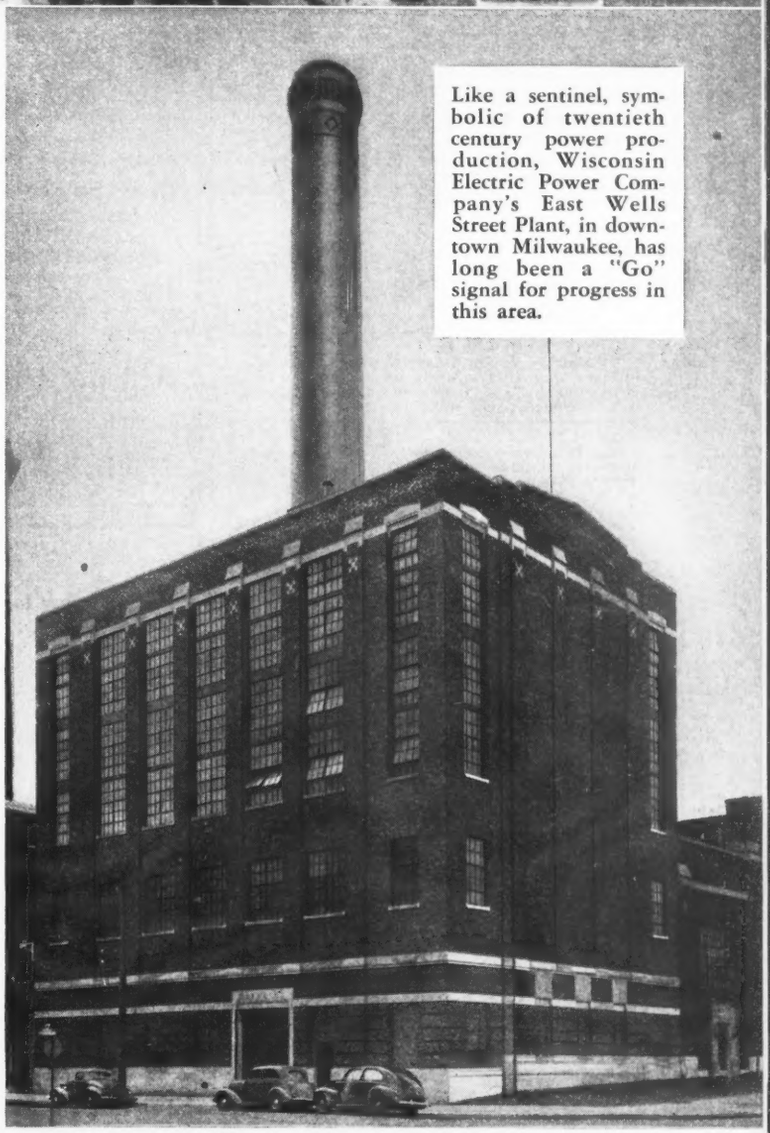


American Blower products used at Lakeside include two Sirocco Fans, six Steel Plate Fans, eight HS Fans and eight Primary Air and Vent Fans. Induced Draft Fan is shown.



American Blower Forced and Induced Draft Fans are functioning as a part of the efficient equipment of East Wells Street Plant. Forced Draft installation (shown here).

THE WISCONSIN ELECTRIC POWER COMPANY, one of America's outstanding public utilities, has long been a leader in reducing the cost of power production. By utilizing modern methods and facilities . . . by sound expansion . . . and by pioneering the development and application of equipment to increase efficiency, this progressive company has cut the cost of power to serve a great, growing community. Most striking evidence of the remarkable advances in plant efficiency is the reduction of heat units required to produce a kilowatt hour—from 25,000 BTU/KWH net in 1922 to only 13,700 BTU/KWH in 1938. American Blower derives great satisfaction from the knowledge that many of its products — including Forced Draft Fans, Sirocco and Steel Plate Induced Draft Fans, Primary Air and Vent Fans—are constantly contributing their full measure of trouble-free, efficient service to the over-all efficiency of this great system. Our Engineers will be glad to cooperate with you, too, in the selection or application of American Blower Mechanical Draft equipment and Fluid Drives (Hydraulic Couplings) for your own plant. Phone, wire or write the nearest American Blower branch office today for complete information.



Like a sentinel, symbolic of twentieth century power production, Wisconsin Electric Power Company's East Wells Street Plant, in downtown Milwaukee, has long been a "Go" signal for progress in this area.

AMERICAN BLOWER CORPORATION

6000 RUSSELL STREET, DETROIT, MICHIGAN

Division of American Radiator and Standard Sanitary Corporation • In Canada: Canadian Sirocco Company, Limited, Windsor, Ontario

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or RESALE

UNDISPLAYED—RATE PER WORD:
Positions Vacant and all other classifications 10 cents a word, minimum charge $2.00.
Positions Wanted (full or part-time salaried employment only), ½ the above rates, payable in advance.
(See ¶ on Box Numbers)
Proposals, 40 cents a line an insertion.

INFORMATION:
Box Numbers in care of our New York, Chicago and San Francisco offices count 10 words additional in undisplayed ads.
Discount of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH
The advertising rate is $6.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
An advertising inch is measured ⅞" vertically on one column, 3 columns—30 inches—to a page.

Copy for new advertisements must be received by December 6th for the Mid-December issue P

POSITION VACANT

MECHANICAL DESIGN ENGINEER. Experienced in high-pressure steam power plant work, piping, structural steel and general mechanical design to direct draftsmen, inspect drawings for correct design and clearances to insure efficiency in erection, operation, and maintenance. Location, midwest. State education, age, experience, and salary expected. Write P-945, Power, 520 N. Michigan Ave., Chicago, Ill.

EMPLOYMENT SERVICE

SALARIED POSITIONS. $2,500 to $25,000. This thoroughly organized advertising service of 29 years' recognized standing and reputation carries on preliminary negotiations for positions of the caliber indicated above, through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If your salary has been $2,500 or more, send only name and address for details. R. W. Bixby, Inc., 270 Delward Bldg., Buffalo, N. Y.

POSITIONS WANTED

(See also "Selling Opportunity Wanted")

YOUNG MAN willing and able, marine and stationary steam licenses, Diesel experience desires operating position with opportunity for advancement. Married, now employed. PW-921, Power, 330 W. 42nd St., New York, N. Y.

COMBUSTION, STEAM and Power Engineer, Age 33. College graduate. Ten years experience in all phases of steam plant engineering from design, erection and service, to supervision and operation of steam power plants. In present employment eight years as Combustion and Power Engineer. Desires position as Ass't or Chief Engineer in industrial power plant. PW-940, Power, 330 W. 42nd St., New York, N. Y.

ELECTRICAL ENGINEER—Maintenance and construction in large industrial plant. References. PW-946, Power, 330 W. 42nd St., New York, N. Y.

CENTRIFUGAL PUMP ENGINEER. Desires connection with progressive manufacturer. All preliminary data on new DS and MS split case line now ready. Over 23 years exclusively in this design field. PW-949, Power, 330 W. 42nd St., New York, N. Y.

MECHANICAL ENGINEER, M.S., age 30, seven years power plant experience covering general operation and maintenance, flow meter engineering and all phases of industrial instruments, specialized in boiler operation, maintenance and efficiency, chiefly pulverized coal. Now employed as field engineer. Desires permanent location with corporation as efficiency or combustion engineer, married. PW-950, Power, 330 W. 42nd St., New York, N. Y.

SELLING OPPORTUNITIES
OFFERED—WANTED
Selling Agencies—Sales Executives
Salesmen—Additional Lines

OPPORTUNITIES WANTED

Established San Francisco Distributor seeks one additional line suitable for marine and industrial power plants. Representative will be in East during December for interview. RA-948, Power, 330 W. 42nd St., New York, N. Y.

BUSINESS OPPORTUNITY

Export Business
Manufacturers of steel products, industrial equipment and special machinery who are interested in export business (South America and The Netherlands) are invited to send particulars to New York export concern. Address BO-947, Power, 330 W. 42nd St., New York, N. Y.

Certified Rebuilding
. . . all types ELECTRICAL machinery and control equipment. State your problem . . . write for prices.
HENDRICKS MOTOR SERVICE
627 FRANKLIN ST. PEORIA, ILL.
22 Years Rebuilding Large Electrical Machinery

We Buy and Sell Used Power Plant Equipment
Boilers ● Engines ● Generators
Electrical Equipment, etc.
INTERSTATE POWER EQUIPMENT CO.
Office and Warehouse
145 Vermont St., Brooklyn, N. Y.

IN LIQUIDATION
340 KW. Full Diesel Plant
consisting of two units 3/60/240 V.
in A-1 condition.
STEPHEN A. DOUGLASS CO.
660 Fort Washington Ave., New York, N.Y.

FOR SALE
Uniflow Engines, with 250 kva generators, 3/60/2300 complete.
Boilers, 2—200 h.p. 200 lb. Heine boilers, complete Boiler Room.
WANTED
5—84"x20" HRT **boilers.**
H. A. WOODWORTH
705 Olive St., St. Louis, Mo. Ch. 6454

FOR SALE TURBOS
1,000 KW Ridgway
500 KW Allis Chalmers
300 KW General Electric
3 phase 60 cycle Condensing, Bargains,
TERMS, TRADE.
CONTINENTAL SALVAGE & MACHINERY CORP.
221 Union Bldg. Cleveland, O.

FOR SALE
Steam Eng. Generator Sets—Uni-flow Engines, also Diesel Engines and **Diesel Generator Sets** as well as **Electric Motors, Boilers** and other machinery.
For further information send for our special list.
SOUTHERN MACHINERY COMPANY
BRENTWOOD, MARYLAND
Phones: Greenwood 2770, Greenwood 3649

Generating Equipment For Sale
1—600 KW **SKINNER Unaflow Engine** Generator Set 3/60/440/2300 — non-condensing.
1—250 KW **WESTINGHOUSE Turbo Generator** 2/60/220 Bleeder type. Can be changed to 3 phase.
Both Perfect Condition.
FS-944, Power
330 W. 42nd St., New York City

OPPORTUNITIES!
in
New and used equipment recently released from service by a number of electric and gas utility companies.
POWER PLANT EQUIPMENT
CONSTRUCTION EQUIPMENT
SUBSTATION EQUIPMENT
TRANSMISSION LINE MATERIALS
Send for new list, . . . to
APPARATUS EXCHANGE
EBASCO SERVICES INCORPORATED
Two Rector St. New York, N. Y.

WANTED

WANTED
STATIONARY DIESEL
150 to 175 H.P. to drive belted Generator. A-1 Condition. State Price and Location.
PEERLESS LAUNDRY
#1520 N. Howard St. Philadelphia, Pa.

GENERATOR SET WANTED
100-150 KW AC 60 Cycle 550 Volt or 2300 Volt Direct Connected Engine-Generator Set, preferably vertical uniflow. If 2300 Volt, transformer of capacity (550 volt secondary) will be required. Must be in A No. 1 condition and low priced. Full particulars and price first letter.
W-943, Power
330 West 42nd St., New York City

GENERATORS WANTED
100 KW and 150 KW Generators 3 phase, 60 cycles, 4 valve or uniflow engines preferred.
W-942, Power,
330 West 42nd St., New York City

THE FINEST REBUILT EQUIPMENT MONEY CAN BUY

Ready For Immediate Shipment

Teletype Designation Union City, N. J. 1750

CHICAGO REP. HOWARD B. JOHNSON, 53 W. JACKSON BLVD.

MOTOR GENERATOR SETS

1—500-kw., 600-V., General Electric, synchronous.
2—500-kw., 250-V., General Electric, synchronous.
1—200-kw., 125 V., G.E. Synchronous.
1—150-kw., 250-V., Westinghouse Synchronous.
2—100-kw., 125-V., G.E., Sq. Cage.
1—100-kw., 125-V., G.E. Synchronous.
1—100-kw., 250-V., Westinghouse Synnchronous.
1— 75-kw., 125-V., Crocker-Wheeler Synchronous.
1— 75-kw., 250-V., G.E., Synchronous.
1— 50-kw., 125-V., G.E. Sq. Cage.
1— 50-kw., 250-V., G.E. Sq. Cage.
1— 40-kw., 125-V., Westinghouse synchronous.

TURBINES

1—500-kw., General Electric, 3 phase, 60 cycle, 480 volt bleeder.
1—400-kw., General Electric, non-condensing.
1—156-kva., Westinghouse, non-condensing.
2—100-kw., Westinghouse, 220 volt, 3 phase, 60 cycle non-condensing.
1—62½ kva., Allis Chalmers-Kerr, 3 phase, 60 cycle, 220 volt.

TRANSFORMERS

3—500-kva., G.E. 13,200/2400 volts.
9—400-kva., Wagner, 2400-240/480 volt.
1—400-kva., G.E. 2400/240-480 volts.
3—333-kva., G.E., 11000/2300 volts.
4—300-kva., Pittsburgh, 4600/115/230 volts.
4—250-kva., Moloney, 7800-220/440 volts.
3—200-kva., G.E. 13,800/460 volts.
4—200-kva., Pittsburgh, 7800/220/110 volts.
6—150-kva., General Electric, 2200-220/440 volts.
2—150-kva., Westinghouse, 2300/230/115-V.
3—150-kva., Pittsburgh, 6600/440 volts.
2—100-kva., General Electric, 2200-220/440 volts.
6—100-kva., Wagner, 2400-120/240 volt.
2— 50-kva., Kuhlman, 2200-110/220/440 volts.
5— 25-kva., Westinghouse Air Cooled, 440/220/220/110 V.
3— 25-kva., General Electric, 2300-230/460 volts.
1— 25-kva., G.E., 440/110-V.
1— 25-kva., G.E., 220/220/110-V.
4— 21-kva., G.E., 440/110-V.
3— 15-kva., G.E., 440/120-V.
4— 15-kva., Westinghouse Air Cooled, 220/440/220/110-V.

SPECIALS

3—40 KW, 60/120 cycle, General Electric, type ITT, Frequency Changer.

2—75 HP, 900 RPM, enclosed fan-cooled squirrel cage motors.

300 KW, General Electric Reduction Gear, 3600/1000 RPM.

75 HP, Poole Reduction Gear, 1770/450 RPM.

75 KW, Ames-Uniflow with Westinghouse 250 v., SK generator.

75 KW, Ballwood engine; Westinghouse, 3 ph., 60 cy., 220 v. Gen.

50 KW, G.E. vertical engine set, 3 ph., 60 cy., 220 volt.

15 KW, Otto Superior diesel with Star, single phase generator, with exciter, panel, radiator, batteries, etc.

2—600 GPM Worthington centrifugal pumps, 278 ft. head.

D.C. GENERATORS

1—500-kw., 900 r.p.m., 250-V., General Electric.
1—100-kw., 600 r.p.m., 125/250-V., G.E.
2— 75-kw., 1200 r.p.m., 125-V., Crocker Wheeler.

MOTORS—3 PHASE, 60 CYCLES

No.	H.P.	R.P.M.	Volts	Type
1	720	514	13,200/6600	G.E., Syn.
1	720	360	440	G.E., Syn.
1	500	450	2200/4000	G.E., Sl. Rg.
1	350	450	440	G.E., Sl. Rg.
1	350	300	440	G.E., Sl. Rg.
1	350	100	220/440	G.E., Syn.
1	300	450	440	Elec. Machy. Syn.
1	300	600	2200	G.E. Sl. Rg.
1	300	720	440	G.E., Sl. Rg.
1	250	450	440	Elec. Machy. Syn.
1	250	400	440	G.E., Syn.
1	240	720	220	G.E., Syn.
1	200	600	440	G.E., Sq. Cg.
2	200	514	220/440/4000	G.E., Syn.
4	200	450	2200/4000	G.E., Sl. Rg.
2	200	514	2200/4000	G.E., Sl. Rg.
1	150	1200	4150	Ideal, Syn.
1	150	600	2200	G.E., Sl. Rg.
2	150	1160	440	G.E., Sq. Cg.
1	150	1730	2200	G.E., Sq. Cg.
1	100	1200	440	G.E., Sl. Rg.
1	100	720	440	West. Sl. Rg.
1	100	1800	440	Al.-Ch. Sq. Cg.

Variable Speed 230 Volt Motors

H.P.	R.P.M.	Type
1—150	300/900	Westinghouse
125	475/950	Westinghouse
100	475/1200	Electro Dyn.
90	470/940	G.E.
75	235/950	Burke
60	600/1200	G.E.
35	500/1500	G.E.
35	500/1250	G.E.
30	600/1200	West.
30	225/900	Cr. Wheeler
25	300/1200	G.E.
25	650/2200	Westinghouse
20	750/1500	G.E.
4— 20	300/1200	G.E.
3— 15	300/1200	G.E.

J. L. HEMPHILL & CO., INC. 801 Williams St., No. Bergen, N. J.

NEW YORK LINE LONGACRE 5-3227 — N. J. TEL. PALISADE 6-2600

The Pick of Power Equipment

60 CY. TURBO GENERATOR UNITS

1—50000 KVA General Electric Cond.
1—18750 KVA General Electric Cond.
1—12500 KVA Westinghouse Cond.
1— 7500 KVA General Electric Cond.
1— 6250 KVA Westinghouse Cond.
1— 6250 KVA General Electric Cond.
1— 5000 KVA General Electric Cond.
1— 4375 KVA Westinghouse Cond.
1— 3750 KVA Westinghouse Cond.
2— 3125 KVA Allis-Chalmers Cond.
1— 3125 KVA General Electric Extr.
1— 2500 KVA General Electric Cond.
1— 1875 KVA General Electric Extr.
1— 1563 KVA General Electric Cond.
1— 1250 KVA General Electric Cond.
1— 1250 KVA General Electric Extr.
1— 625 KVA General Electric Cond.

1—6250 KVA Allis-Chalmers Non-C.
1—1875 KVA Westinghouse Non-C.
1—1666 KVA General Electric Non-C.
1—1250 KVA Allis-Chalmers Non-C.
1— 944 KVA Westinghouse Non-C.
1— 625 KVA Westinghouse Non-C.
1— 375 KVA General Electric Non-C.
1— 112 KVA Allis-Chalmers Non-C.

D.C. Turbo Units

1—2000 KW Westinghouse 250 V. 3 wire.
1—1000 KW Crocker-Wheeler 250 V.
1— 300 KW General Electric 250 V.
1— 300 KW General Electric 125 V.
1— 200 KW General Electric 125 V.
1— 200 KW General Electric 250 V.
1— 100 KW General Electric 125 V.

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT.

BREW, WOLTMAN & CO., INC.

50 CHURCH STREET, NEW YORK CITY

DECEMBER SPECIALS

UNIFLOWS

1 500 KW Skinner Uniflow
1 250 KW Ames Uniflow

A.C. TURBO-GENERATORS

2 500 KW Condensing
1 200 KW Non-Condensing
1 100 KW Non-Condensing

AIR COMPRESSORS

2 1300 CFM, C.P. OCE
Synchronous Motor Driven
1 360 CFM, I-R, XRB, 200#
1 700 CFM, Sullivan WJ3, 125#

"We Want Your Surplus Equipment"

BRILL EQUIPMENT CORP.

183 Varick St.
NEW YORK, N.Y.

UNIFLOW and 4 VALVE UNITS

KVA	MAKE
900	G.E.-Hamilton Poppet V.
750	G.E.-Erie City Poppet V.
500	G.E.-Erie Ball 4 V.
450	G.E.-Skinner Uniflow
438	G.E.-Murray Corliss
430	Ridgwy-Ridgwy Cross Comp (non-condens)
375	G.E.-Skinner Uniflow
375	G.E.-Nordberg Uniflow
312	Wghse.-Chuse 4 V.
312	G.E.-Harrisburg 4 V.
312	G.E.-Chuse Uniflow
250	Ridgwy-Ridgwy 4 V.
250	G.E.-Skinner Uniflow
187	G.E.-Erie Ball 4 V.
187	G.E.-Skinner Uniflow
150	Wghse.-Erie Ball 4 V.
100	Wghse.-Chuse 4 V.
100	G.E.-Harrisburg Uniflow

OIL BURNER UNIT

Ames fuel oil pumping and heating unit with pumps, oil heaters, regulators, burners; used with (2) 750 HP Boilers.

BOILERS (ASME)

1000 HP Casey Hedges, 160 lbs. (3)
413 HP Wickes Cross Drum, 160 lbs.
300 HP Heine, 200 lbs. (2)
323 HP Springfield Cross Drum, 200 lbs. (2)
323 HP Springfield Cross Drum, 250 lbs.
250 HP Heine, 200 lbs.

BALANCER SETS

(2) 150 KW Wghse. 125/240 volt

TURBINE UNITS

KW	MAKE AND TYPE
5000	Al.-Chal. (non-con)
5000	G.E. (condens)
2500	G.E. (mixed pres. or bleeder)
2500	Al.Chal (condens)
2000	Wghse. (condens or bleeder)
1000	G.E. (condens)
750	Wghse. (non-con)
750	Al.Chal-Kerr (condens or mixed pres.)
600	G.E. (mixed pres. or bleeder)
500	G E. (condens or bleeder)
375	G.E. (condens)
375	G.E. (non-con)
100	G.E. (non-con)
75	Wghse. (non-con)

POWER PLANT EQUIPMENT CO., INC., 39 Cortlandt Street, New York, N. Y.

SLIP RING MOTORS, 3-PH., 60-CY.

HP	Volts	Make	Speed
400	220-440	G.E.	900
300	220-440	G.E.	600
300	2300-4000	G.E.	1200
200	2200-550	G.E.	1800
200	220-440	Whse.	514
150	2200-440	Whse.	1800
150	2200-220-440	G.E.	600
100	2200-220-440-550	G.E.	720
100	2200-440-220	G.E.	600
100	220-440	G.E.	900
100	220-440	G.E.-MTC	900
80	220-440	G.E.-MTC	900
75	220-440	G.E.	720
60	220-440	G.E.	720
50	2200	G.E.	514

SYNCHRONOUS MOTORS 3-PH., 60-CY.

300	220-400	G.E.	600
240	2300-550	G.E.	900
240	2200-440-220	G.E.	600
200	440-220	G.E.	720
200	2400-4150	G.E.	1200
125	220-440	G.E.	300
60	2200-440-220	G.E.	1200
30	220-440	Ideal	1200

TRANSFORMERS—60 CYCLE

3—1500 kva., G.E. type H-D, 23000-2300/4000 Y.
3—500 kva., Maloney Type C 13200-460.
6—400 kva., G.E. type H-KD 22000-2200
3—400 kva., Westinghouse 2400-240/480
3—333 kva., G.E. type H-KDD 13800-230/460
3—333 kva., G.E. Type H-KS 2300-230/115
3—250 kva., G.E. type H-KD 23000-2300
4—175 kva., Moloney OISC 13200-440
3—150 kva., G.E., type H 2300-230/460
3—100 kva., G.E., type H-KR 6600/13200-2300
3—100 kva., G.E. type H-K 2300-230/460
3—100 kva., Westinghouse, 13200-115/230
3—100 kva., Pittsburgh, type OISC 2400-240-120
3— 75 kva., Packard, type A, 2300-460-230
3— 75 kva., West. Type SK 2400-480/240/120
3—37½ kva., G.E. type H-K 2200-460
3— 25 kva., G.E., type H-K 2300-230/460
3— 25 kva., G.E. type H-K 460-115/230

A. C. GENERATORS

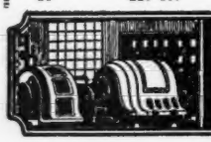
1—312 kva., 900 r.p.m., 2300-V., Westghse.
1—300 kva., 600 r.p.m., 240-480 V., G.E.
1—225 kva., 600 r.p.m., 2200-240-480-V., G.E.
1—187 kva., 900 r.p.m., 2200-550-V., Westghse.
1—112½ kva., 900 r.p.m., 240-480 V., G.E.
1—56 kva., 1200 r.p.m., 2200-480-240-V., G.E.
1—31 kva., 1200 RPM., 240-480 Ideal

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440-220	G.E.	IK	1200
500	440-220	G.E.	IK	900
220	550	Whse.	CS	720
150	2200-440-220	Whse.	CS	600
150	2200	G.E.	IK	1800
150	2200	Allis Ch.	AN	450
100	440-220	G.E.	KT	1200
100	2200-550	G.E.	KT	900
100	220-440	G.E.	KT	900
75	220-440	G.E.	KT	900
50	220-440	G.E.	KT	900
50	2200	G.E.	K	1200

MOTOR GENERATOR SETS

1—200 kw., 250 V., 1200 r.p.m., Ridgway, direct connected to 300 HP, 2200 V., 3 ph, 60 cy, syn. motor.
1—150 kw., 125 V., 1200 r.p.m., G.E. type MPC direct connected to G.E. type A.T.I., 225 HP, 2300 v., 3 ph., 60 cy. syn. motor.
1—100 kw., 125 V., 1200 r.p.m., Electric Machinery, direct connected to 125 kva., 2300/4000 V., 60 cycle, syn. motor.
1—50 kw., 125 V., 1200 r.p.m., G.E., type C.D., compound wound, direct connected to G.E. type KT, 75 HP, 220/440 V. 3 ph. 60 cycle motor.



STEPHEN HALL & COMPANY, INC.

458 Seventh St., Hoboken, N.J.

SUB STATIONS

550 KW Burke 250 V. 2300/3/60 M.G. Syn.
300 KW West. 250 V. 2200/3/60 M.G. syn.
200 KW West. 250 V. 2300/4000/3/60 Rotary
200 KW West. 250 V. 2300/3/60 M.G. Syn.
200 KW West. 550 V. 2200/3/60 M.G. syn.
150 KW West. 250 V. 2300/4000/3/60 M.G. Syn.
125 KW Cr. Wh. 250 V. 220/440/3/60 M.G.
100 KW Ridge 250 V. 2200/3/60 M.G. Syn.
75 KW West. 250 V. 2300/3/60 M.G.
50 KW Al Ch. 250 V. 220/440/3/60 M.G.
30 KW West 230 V. 220/3/60 M.G. Syn.

ENGINE GENERATOR SETS

500 kva. 8 PF, 400 kw. 240/3/60 G.E. dir. con. 22"x30" Erie Ball 4 vlv. eng. 150#
300 kw. West. 250 V. D.C. Skinner Uni.
300 kw. G.E. 3/60 Skinner Uniflow
125 kva. Allis Chal. 220/440 Turbo
60 kw. A.C. Buckeye Full Diesel
60 kw. 250 V. DC West. Buckeye Diesel

COMPRESSORS

578 CFM 10-15x12 Chicago 60# steam
534 CFM 16x14-10x14 I.R. 100# elec.
485 CFM 14x10 I.R. 60# pres. elec.
255 CFM 14x9 Bury 2 stage elec.

CRANES

7½/15 ton Maris 230 V. D.C. 35' 7" span with runways
10 ton Euclid 230 V. D.C. monorail
3 ton Shepard 230 V. D.C. monorail

TRANSFORMERS

3—333 kva. Pgh. 2300-115/230 1/60
1—100 kva. West. 6600-220/110 1/60
3—50 kva. Allis 2300-220/110 1/60
3—37½ kva. West. 22000-2200 1/60

SLIPRING MOTORS

4—700 HP G.E. 2300/3/60 393 rpm.
4—500 HP G.E. 2300/3/60 450 rpm.
2—300 HP W. 2200/3/60 580 rpm.
1—200 HP West. 2200/3/60 580 rpm.
1—200 HP West. 2200/3/60 690 rpm.
1—200 HP Westg. 440/3/60 500 rpm.
1—150 HP G.E. 2200/3/60 435 rpm.
1—100 HP G.E. 220/3/60 600 rpm.
1— 75 HP Westg. 220/3/60 850 rpm.
1— 50 HP Westg. 220/3/60 430 rpm.
2— 50 HP Al. 220/3/60 900 rpm.

DUQUESNE ELECTRIC & MFG. CO.
PITTSBURGH, PA.

TURBO UNITS

1—3500 KW **Westinghouse** High Pressure Condensing, 3/60/2300/3600.
2—2000 KW **General Electric**, same as above.
1—1500 KW **Westinghouse**, same as above.
2—1000 KW **General Electric**, same as above.
1— 750 KW **General Electric**, same as above.
1— 750 KW **Westinghouse**, same as above, except non-condensing.

ENGINE UNITS

1—750 KVA **General Electric**, 3/60/2300 connected to 29x36 Skinner Universal Uniflow Steam Engine.
1—430 KVA **Ridgway**, 3/60/240 volt AC Generator direct connected to Ridgway cross-compound Corliss Steam Engine.

TIPPINS MACHINERY CO.
436 Seventh Ave. Pittsburgh, Pa.

ELECTRICAL BARGAINS

1—**360 KVA**, 220 volt, **Gen. Elec. Capacitor**, with rack and transformers.
1—**400 KW**, 125/250 volt, **Ridgway Unaflow Unit**, engine 24x28: about 10 years old.
1—**150 KW**, 250 volt, **Gen. Elec.** to 18x20 Skinner unaflow engine: fine condition.
1—**6000 KW**, 3 phase, 60 cycle, 2300 V., 3600 rpm, **Gen. Elec. Turbo Generator** with Worthington surface condenser.
1—**360 HP Fairbanks-Morse full Diesel**, still on original foundation: excellent condition.
1—**2000 KW**, 3 ph., 60 cycle, 2300 V., 3600 rpm, **Gen. Elec. Turbo Generator:** fine shape and a real bargain before removal.
1—**2100 HP**, 3 ph., 60 cycle, 2300/4600 V., 514 rpm, **Gen. Elec. Syn. Motor.**
1—**300 KW**, 250 volt, 1200 rpm, **Westgh. Generator** to a 420 HP, Westgh., 2300 V. syn. motor.
4—**550 KVA**, 2300x115/230 V. **Kuhlman Transformers.**

This is just a partial list of our immense stock. We have Motors, Generators, Oil Circuit Breakers, etc.

Send for Catalog

WHAT HAVE YOU FOR SALE?

GEORGE SACHSENMAIER CO.
8403 Hegerman St.
Holmesburg Phila., Pa.

SYNCH. MOTOR GENERATORS

750 KW WEST. 250 V. 2400 A.C., 900 RPM
300 KW G.E. 250 V. 2300/4000 A.C., 1200 RPM
200 KW G.E. 250 V. 2300/4000 A.C., 1200 RPM
200 KW G.E. 550 V. 2300/4000 A.C., 1200 RPM
150 KW G.E. 250 V. 2300/4000 A.C., 1200 RPM
150 KW WEST. 250 V. 2300/4000 A.C., 1200 RPM
100 KW G.E. 250 V. 2300 A.C., 1200 RPM

SYNCHRONOUS CONVERTERS

300 KW G.E. 250 D.C. 2300/4000 A.C., 1200 RPM
300 KW G.E. 550 D.C. 2300/4000 A.C., 1200 RPM
200 KW G.E. 250 D.C. 2300/4000 A.C., 1200 RPM
200 KW R.W. 250 D.C. 2300/4000 A.C., 1200 RPM
150 KW R.W. 250 D.C. 2300/4000 A.C., 1200 RPM

AIR COMPRESSORS

1302' I-R PRE-2, Dir. Con. 440 V. Syn. Mt. 100#
1052' I-R XCB Belted 2200 V. Syn. Mt. 100#
1050' I-R PRE-2, Dir. Con. 2300 V. Syn. Mt. 100#
676' I-R XRE, Dir. Con. 2300 V. Syn. Mt. 100#

(Each unit listed above is owned by us and is only a small part of our large stock, consisting of Battery and Trolley Locomotives, Transformers, Motors, Coal Crushers and Wheel Presses.)

WHAT HAVE YOU FOR SALE?

WALLACE E. KIRK COMPANY
Incorporated
502 Grant Building, Pittsburgh, Pa.

TURBO GENERATOR

625 KVA, 2300 V., 60 Cycle, 3 Phase, G.E. Condensing—Complete

ENGINE GENERATORS

200 KVA, 240 V., 60 Cycle, 3 Phase, Westinghouse-Hamilton.
720 KVA, 440 V., 60 Cycle, 3 Phase, G. E. Hamilton.
900 KVA, 2300 V., 60 Cycle, 3 Phase Westinghouse-Hamilton Twin Simple.

BOILERS

One—400 H.P. 3-Drum, 160 Lbs.
One—600 H.P. B&W Straight Tube, 200 Lbs.

JAMES T. CASTLE
424 First Ave. Pittsburgh, Pa.

Electric Power Equipment For Sale

Motors, Generators, Engines, M. G. Sets, Transformers, Compressors, Rotary Converters, Turbo Units, Pumps, etc.

R. SCHEINERT
2132-34 E. Susquehanna Ave., Phila., Pa.

WATER TUBE BOILERS

2—380 H.P. each, Heine National Board, new 1926, pressure 180#. Immediate delivery.

Also other types and sizes in stock.

M. J. HUNT'S SONS 1600 N. Delaware Ave. Phila., Pa.

TRANSFORMERS

WE SELL—PURCHASE—RENT

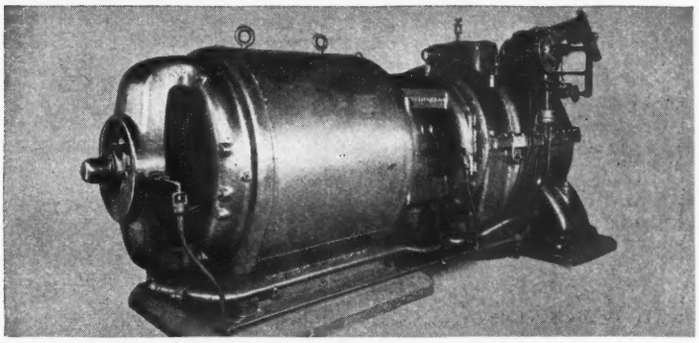
Power & Dist. Transf. From One to 5000 KVA. Any Volt. or Frequency

Catalogue and Prices on Request

Philadelphia Transformer Co.
2829 Cedar St. Phila., Pa.

Reconditioned Motors, Generators, Control Equipment, etc.
Send for 32 page stock list.
Electric Apparatus & Repair Company
Specialists on Rebuilding Motors, Generators and Controls
1410 No. 6th St., PHILA., PA.

Turbo-Generators



AUTOMATIC EXTRACTION, 750 KVA. GENERAL ELECTRIC TURBINE-GENERATOR.

1—G.E., 7500 KVA, 3/60/2300-v, 300#, 150° TT, Surface Condenser.

1—WEST. 3750 KVA, 3/60/2300-v, 200#, 500°TT Condensing.

2—ALLIS-CHALMERS, 3125 KVA, 3/60/6600-v, 200#, Condensing.

1—G.E., 1875 KVA, 3/60/2300-v, 200#-450°, Condensing.

1—G.E. 1563 KVA, 200#, 500°TT, 3/60/2300-v, Condensing.

1—ALLIS-CHALMERS, 1250 KVA, Condensing: 3/60/480-v: 200# G, 475° TT.

1—G.E. 1250 KVA, 3/60/2300-v, 175#, 10# Back Pressure, Non-condensing.

1—ALLIS-CHALMERS 1250 KVA, 3/60/2300-v, 210#, 100°F.TT, Surface Condenser.

1—G.E. 937 KVA, 3/60/480/2300-v, 250# 600°TT, Condensing.

1—G.E. 750 KVA, 3/60/480-v, 250#, 550° TT, 30# G. Extraction

1—MOORE-ALLIS 375 KVA 480/2300-v, Non-condensing, 250#, 600°, 5-25# Back Pressure.

WILMS, WEAVER & CO. Union Guardian Bldg. DETROIT, MICH.

We Deal in Turbo-Generators Exclusively

SLIPRING MOTORS

H.P.	Make-Type	Volt.	RPM
250	A.-C.	2200	505
152	G.E.-IM	2200	720
112	G.E.-ITC5014	220/440	720
100	A.-C.	2300	685
75	G.E.-MT-343	220/440	1200
75	G.E.-MT-552	220/440	900

SQ. CAGE MOTORS

H.P.	Make-Type	Volt.	RPM
400	G.E.-KT-565	2200	1180
200	A.-C.	2200	1170
200	A.-C.	200	1760
200	Cr. Wh.	220/440	720
(2)150	A-C-AR226BS	2200	1760
100	A.-C.AR226C	220/440	1170
100	A.-C.	2200	1170
75	G.E.-KT-537	220/440	1755
(2) 75	G.E.-IK	220/440	695

A.C. GENERATORS

200 K.W. G.E. ATB, 80% P.F. 720 RPM.
150 KVA G.E. TRB, 900 RPM.
100 KVA West, 1200 RPM.
90 KVA Triumph, 360 RPM.
75 KVA G.E. 1200 RPM.
50 KVA West. 1200 RPM
40 K.W. Burke, 1200 RPM.
32 K.W. Fair.-Morse, 1200 RPM.
25 K.W. Star, 1800 RPM.
20 KVA G.E. 1200 RPM.
15 KVA G.E. 1200 RPM.

230 VOLT VARIABLE SPEED MOTORS

H.P.	Make	Type	RPM
100	G.E.	CO1831A	675/1700
100	Cr.-Wh.		550/900
75	El.-Dy.		700/1050
75	Reliance		405/1675
(2) 70	El.-Dy. fr. 525		475/1050
60	El.-Dy. fr. 475		450/900
(2) 50	G.E.	CO1810A2	725/1800
(2) 35	Reliance		405/675
30	G.E.	LC24	825/2000
25	West.	SK	600/1200
(2) 25	Reliance fr. 310		405/675
20	G.E.	RLC	600/1800
15	Cr.-Wh.	CMC	900/1800
15	West.	SK-90	825/1650
15	G.E.	RF-11	400/1200
8	West.	SK	300/450
(2) 6	G.E.	RF	450/1800
(2) 5½	West.	SK-60	500/1500
5	G.E.	RF-10	300/1200

230 VOLT D.C. MOTORS

H.P.	Make	Type	RPM
150	G.E.	RC-36	1750
100	G.E.	CD-123	1150
75	G.E.	CD-115	1150
75	Burke	WA-9	1140
75	G.E.	SK-160	850
75	El-Dy.	311N	400
60	Roth.		600
40	Star		1800
40	G.E.	CD	1150

SYNCHRONOUS MOTORS

H.P.	Make	Type	Volt	RPM
300	West.		2200	600

D.C. MOTOR GENERATOR SETS

175 K.W. G.E. MPC, 230 V. 1200 RPM cpd. interpole generator, 3 ph. 60 cy. 2300 V. Motor.
150 K.W. Ridgway 230 V. 900 RPM. cpd. interpole, 3 ph. 60 cy. 220/440 V. Synch. Motor.
100 K.W. Ridgway 275 V. Synch. Converter, 1200 RPM, 3 ph. 60 cy. 4100/2300 V.
100 K.W. Burke, 3 wire, 125/250 V. 900 RPM. 3 ph. 60 cy. 2300 V. Synch. Motor.
75 K.W. West. SK, 125 volt, 1200 RPM, 3 ph. 220/440 Synch.
60 K.W. West. 125 V. 1200 RPM, 3 ph. 60 cy. 220/440 V. Synch. Motor.
30 K.W. G.E. CD 250 volts, 1800 Motor 3 ph. 220/440 volts.

ELECTRIC HOISTS

6 Ton Yale & Towne Cable, 230 volt, D.C.
5 Ton Shepard. 220 volt, A.C.
4 Ton G.E. 230 volt, D.C.
2 Ton Shepard. 110 volt, D.C.
2 Ton American. 220 volt, A.C.

Synchronous starting equipment, Automatic D.C. starters, panel boards, starters, welders, platers, blowers, frequency changers, etc.

Send us all your inquiries!

L. J. LAND AND COMPANY

ESTABLISHED 1910 **1 YEAR GUARANTEE**

144 Grand St.—CAnal 6-3923-4 & 5—New York, N. Y.

BARGAIN OFFER

180k.w. G. E. GENERATOR

220V—3 PH—60—600 RPM
TYPE ATB—.8 P.F.—DIRECT-CONNECTED EXCITATION
FULLY GUARANTEED—$750.00

MOTORS GENERATORS

Fans—Blowers—Equipment

Large complete stock

PARISER ELECTRIC MOTOR CO., INC.

165-7 Centre Street, N. Y. C.

ONE YEAR GUARANTEE

Synchronous Motor Generators:
100 K.W. G.E. 3/60/2200-250-275 volt, 1200 rpm.
150 K.W. G.E. 3/60/2200-250-275 volt, 1200 rpm.
200 K.W. G.E. 3/60/2200-250-275 volt, 900 rpm.
540 K.W. Allis-Chalmers 3/60/2300v., 250-275 volt.

Synchronous Converters:
2—100 K.W. G.E. 275v. D.C. 2300v., A.C., 1200 rpm.

Slip Ring Electric Motors: A. C.
52 H.P. G.E 3/60/220-440v, 1200 rpm.
(3) 100 H.P. G.E. 3/60/220-440v., 900 & 1200 rpm.
80 H.P. G.E.-MTC 3/60/220v., 900 rpm.

Air Compressors:
(9) ELECTRIC: 676, 870, 1300, 1500, 1722 & 2850 Ft. & 420 Ft. Cap.
(6) BELTED: 368, 540, 676, 1000 & 1302 Ft.
(14) STEAM: 368, 542, 876, 1422 & 2000 Ft.
(3) DIESEL: 357, 502, 676 & 1,000 Ft.
(12) GASOLINE: 110, 220, 310 & 1300 Ft.

Complete Plants Bought and Sold.

R. C. STANHOPE, INC.
875 Sixth Ave. New York, N. Y.

STEAM—ELECTRIC—DIESEL

WE SUPPLY **COMPLETE POWER PLANTS**

WATER TUBE BOILERS; Sizes 100 HP to 2000 HP
TURBO-GENERATORS; Sizes 50 KW to 7500 KW
ENGINE-GENERATORS; Sizes 50 KW to 1000 KW

CHARLES B. REARICK, 30 Church St., New York

MOTOR GENERATOR SETS

3 ph.—60 cy. Synchronous Motors

1500 KW West'house 250 volts DC, 514 RPM
600 KW Al. Chalmers 275 volts DC, 600 RPM
500 KW Gen. Elec. 275 volts DC, 720 RPM
300 KW Gen. Elec. 275 volts DC, 720 RPM
300 KW Gen. Elec. 600 volts DC, 720 RPM
240 KW Gen. Elec. 250 volts DC, 1200 RPM
200 KW Gen. Elec. 275 volts DC, 1200 RPM
200 KW Gen. Elec. 120 volts DC, 900 RPM
200 KW Gen. Elec. 70/140 volts DC, 3-unit
150 KW West'house 275 volts DC, 1200 RPM
150 KW Gen. Elec. 600 volts DC, 1200 RPM
100 KW Gen. Elec. 250 volts DC, 1200 RPM
100 KW Gen. Elec. 125 volts DC, 1200 RPM
75 KW Gen. Elec. 250 volts DC, 1200 RPM
75 KW Gen. Elec. 125 volts DC, 1200 RPM

SPECIAL OFFERINGS

1—3000 KW Gen. Elec. 225/285 volt DC Rotary Converter, 6 phase, 60 cycle

5—360 KVA to 2500 KVA 3 phase, 25/60 or 60/25 cycle Frequency Changers

1—500 KVA Westinghouse Synchronous Frequency Changer, 3 phase, 25/60 or 60/25 cycles, 240/480/550/2300 volts, 750 RPM, with direct connected exciters.

1—625 KVA Al. Chalmers Low Pressure Condensing Turbo Generator, 480/240 volts, 3 phase, 60 cycle, 3600 RPM, 16# abs. or 150# ga. steam pressure

3 PHASE, 60 CYCLE MOTORS

1500 HP Slipring 300 RPM
710 HP Gen. Elec. Synchronous, 720 RPM
650 HP Al. Chal. Synchronous, 1200 RPM
450 HP Gen. Elec. Squirrel Cage, 720 RPM
315 HP Gen. Elec. Synchronous, 600 RPM
300 HP Gen. Elec. Slip Ring, 514 RPM
300 HP West. Slip Ring, 360 RPM, New. (2)
250 HP Gen. Elec. Squirrel Cage, 1800 RPM
250 HP Al. Chal. Squirrel Cage, 600 RPM
200 HP West. Slip Ring, 720 RPM
200 HP West. Synchronous, 225 RPM
150 HP Gen. Elec. Synchronous, 900 RPM
150 HP Gen. Elec. Slip Ring, 900 RPM (2)
150 HP Gen. Elec. Slip Ring, 600 RPM
100 HP West. Slip Ring, 600 RPM (2)
75 HP West. Slip Ring, 720 RPM (2)
50 HP West. Slip Ring, 1200 RPM (12)

CHICAGO ELECTRIC COMPANY 1320 W. 22nd St., Chicago, Ill.

3 POWER PLANTS FOR SALE

All 2300 V. 60 cy. 3 ph. 3600 Rev. Turbos with sur. cond. piping, valves, stokers, heaters and auxiliaries as now installed.

PLANT NO. 1
2—1000 KW. **G.E. BLEEDER TURBOS**
3—516 HP. 200# **Code Stirling Boilers**

PLANT NO. 2
1—2000 KW. **G.E. Turbo** with Sur. Cond.
2—400 HP. **Stirling Boilers** 180# Code

PLANT NO. 3
1—1000 KW. **G. E. turbo**
2—295 HP. **Stirling 200# Boilers**—stokers —piping auxs. etc. etc.
1—**Water Softener** 400 G.P.H. Capacity.

Sell above as whole or part

Northern Indiana Power Company
Jno. Walker, Ch. Eng.—
Indianapolis, Ind.

-TRANSFORMERS-

SPECIAL

40— 5 KVA Allis-Chalmers, 6900-115/230 V.
35—25 KVA Gen. Electric, 6900-230/460 V.
Prices quoted on request.

We Rewind, Repair and Redesign all Makes and Sizes
ALL TRANSFORMERS GUARANTEED FOR ONE YEAR
Write for Catalog No. 134-F

THE ELECTRIC SERVICE CO., INC.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
STATION M Since 1912 CINCINNATI, OHIO

Large A.C. Generators

1250 KW. 3 phase 60 cycle 2300-600-480 volt 300 rpm General Electric 3-bearing generator.
500 KW. 3 phase 60 cycle 600 volt 360 rpm General Electric 3-bearing generator.
450 KW. 3 phase 60 cycle 2300-600-480 volt 360 rpm General Electric 3-bearing generator.
450 K.V.A. 3 phase 60 cycle 480/240 volt 360 rpm General Electric 3-bearing generator.
300 KW. 3 phase 60 cycle 2300 volt 300 rpm General Electric 2-bearing generator.
242 H.P. 2 phase 60 cycle 2300 volt 514 rpm General Electric synchronous motor.
225 K.V.A. 3 phase 60 cycle 480 or 600 volt 600 rpm Fairbanks ball bearing 2-bearing machine, suitable for direct connection.

Turbines

1500 KW. 3 phase 60 cycle 600 volt 3600 rpm General Electric generator to a 1500 KW. 4-stage General Electric turbine, condensing.

Uniflow Engine Generator Sets

325 KVA, 3 phase, 60 cycle, 240/480 volts Allis-Chalmers Generator, connected to Skinner Universal Uniflow steam engine, complete installation.
2—125 KW. 3 phase 60 cycle 550 volt General Electric generators, to 17x16 Skinner uniflow engines.

Send us your inquiries for power plant equipment

ANDREN-MYERSON CORP.
411 Atlantic Ave. Boston, Mass.

POWER PLANT EQUIPMENT

TURBO-GENERATORS
750 KW. G.E. Non-Cond. 2300 V.
1250 KW G.E. Non-Cond. 550 V.
100 KW. G.E. Non-Cond. 3-60-550 V.

BELTED GENERATOR
500 KVA. G.E. 225 RPM-3-60-550 V.

AIR COMPRESSORS
2—1775 Cu. Ft. I R Duplex 25 lbs.
1—1090 Cu. Ft. Chic. Motor Drive, 550 V.
1—2865 Cu. Ft. I. R. 35 lbs. Motor 2300 V.

BOILERS
2—600 H.P. Heine 250 lbs. ASME.
1—518 H.P. Heine 250 lbs. Mass. Std.
1—300 H.P. B. & W. Sterling 150 lbs.
3—200 H.P. H.R.T. 160 lbs. Mass. Std.

FOUNDRY EQUIPMENT
1—4 Ton Charging Scale Car. Never Used.

INDUCTION VOLTAGE REGULATOR
195 KVA G.E. Prim. volts 11,000 sec. amps. 137

A. LEE ELLIS CO., U. S. Mchy. Bldg., Boston, Mass.

The Buyer Must Be Satisfied—Always

WE BUY AND SELL

Power Plants, D.C. and A.C. Motors, Generators, Transformers, Pumps and Elec. Instruments. Give us the opportunity of bidding. NOTE: We carry a diversified stock and your inquiries will receive immediate attention. Satisfaction guaranteed.

Superior Electric Machinery Co.
2829 Cedar St. Philadelphia, Pa.

1—1035 HP **B&W** 250# pres. boiler, complete with Taylor stoker, economizer.
6—600 HP **B&W boilers**, 200# pres. complete plant.
1—300 HP Vogt 200# **Stirling** type **Boiler.**
1—310 HP Heine 200# pres. boiler, Westg. stoker.
2—600 HP **Heine Boilers**, 250 lbs., pressure, complete.
2—350 HP **Stirling Boilers**, 200# pres. oil burners.
1—600 HP **B&W** straight tube **Boiler**, 200# pres.
3—516 HP **Stirling Boilers**, 200# pressure, with chain grate stokers, complete plant.
6—720 HP **Sterling Boilers**, 180# pressure, stokers.
3—750 HP **Sterling Boilers**, 200# pres., with stokers.
1—500 KW 3 phase, 60 cycle, **Westinghouse Non-condensing Turbine.**

1—2000 KW **Westinghouse Condensing Turbine** complete. Jet condenser.
2—1250 KW **G.E. Extraction Turbines**, complete, surface condensers, all auxiliaries.
2—125 KVA **Skinner** (counterflow) **Eng. Gen. sets.**
1—750 KW **Al-Ch.** 3-60-2300 v. **Condensing Turbine.**
1—280 KW 3 phase, 60 cycle, 480 V. Ball non-releasing **Corliss** engine, rebuilt.
1—2500 KVA **General Electric** condensing turbine, all auxiliaries.
1—27x32 **Skinner Uniflow**, direct connected to 450 KVA G.E. generator, complete.
3—312 KVA **Skinner uniflow Eng. gen. sets**, complete.

• The above is only a partial list. Send us your inquiries.
LIST YOUR EQUIPMENT WITH US.

SEE *Fletcher* FIRST!
FLETCHER SALES CO.
835 Security Trust Bldg. INDIANAPOLIS, IND.

STEAM TURBINES

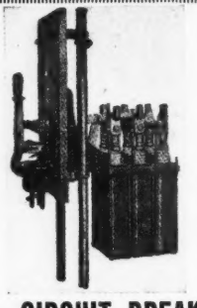
60 Cycle, 3 Phase-Condensing

1—15000 KW. Gen. Elec. 11,000 V., 1800 RPM.
1— 7500 KW. Gen. Elec. 2500/5000 V., 1800 RPM.
1— 7500 KW. Gen. Elec. 6600 V., 1800 RPM.
2— 5000 KW. Gen. Elec. 13200/6600 V., 3600 RPM.
1— 5000 KW. Gen. Elec. 2300 V., 1800 RPM.
1— 5000 KW. Gen. Elec. 4000 V., 3600 RPM.
2— 1500 HP. Kerr 3600 RPM. EXTRACTION, Steam Ends Only.
2— 1500 KW. Gen. Elec. 2300 V., 3600 RPM.
1— 1000 KW. Gen. Elec. 2300 V., 3600 RPM.
1— 750 KW. All. Ch., 2300 V., 3600 RPM.
1— 500 KW. Gen. Elec. 2300 V., 3600 RPM.
1— 250 KW. All. Ch., 2300 V., 3600 RPM. Mixed Pressure or Condensing.

ARCHER & BALDWIN, INC.
75 WEST STREET, NEW YORK, N. Y.
Tel.—BOwling Green 9-9275-9276.

TRANSFORMERS MOTORS
MG SETS PLATERS

3—300 KVA **GE Transformers** 60 cy 4600/230/460
3—150 KVA **West Transformers** 60 cycle 4600/230/460, newly rewound
2—1500/750 Amp 6/12 Volt **Platers**
200 HP **GE** 1-K-60/3/440/720 with Starter
150 HP **West. Sync.** 60/3/2200/900 driving 100 KW 230 V. **West. SK Generator**
4 **MG Sets Westinghouse**—Motors 60/3/2200 Generators 1000 Amp 60 Volt and 3000 Amp. 60 Volt
200 HP **G.E. Synchronous Motor** 25/3/220/750
4—75 HP **West. Ty S-Motors** 230 V.D.C. 475 R.P.M.
500 New 16"-18" **Exhaust Fans.**
LARGE STOCK OF FREQUENCY CHANGERS
Send us your inquiries
10,000 ITEMS AVAILABLE
Erie Electric Motor Repair Co., Inc.
124 Church St. Buffalo, N. Y.



OIL SWITCHES
AIR CIRCUIT BREAKERS
SAFETY SWITCHES
BOUGHT — SOLD

CIRCUIT BREAKER COMPANY
347 N. Clinton Ave., Rochester, N. Y.

"IMMEDIATE DELIVERY — 50% PLUS SAVING — AA NO. 1 POWER EQUIPMENT"

AVAILABLE NOW, SUBJECT CURRENT TREND OF MOMENTARY RETENTION IN SERVICE OWING TO UNIVERSAL PEAK DEMAND

UNITS ARE RARE IN THE ANNALS OF AVAILABILITY AND DELIVERY OFFERED UNDER THORO ENGINEERING CHECK OF DESIGN LOG SERVICE AND INSPECTION RECORD AND MAY BE REGARDED SUBJECT VERIFICATION AS WORTHY AND DEPENDABLE IN LINE WITH THE PRECEDENT OF PS&CO OPERATING INVARIABLY UNDER A PLAN OF INTEGRITY OF PURPOSE AND PERFORMANCE FOR OVER FORTY YEARS.

Turbo Units 60 Cycle

A. 18,750 KVA 23 Stage Curtis Steel Frame 250/400# Design and Redesigned—60/3/11500/-1800. (Economy 10.5 at 200#). Complete modern layout with surface condenser. (See illustration "A")

B. 45,000/50,000 KVA 21 Stage Curtis Steel Frame 250/400# Design and redesigned—60/3/-12500/1200. (Economy 10.7 at 200#). Surface Condenser complement available from other stores. (See illustration "B")

C. 2—12,500 KVA Multiple Expansion Parallel Flow Condensing Turbo Units — 60/3/2300/1800 Surface Condenser equipped.

D. 10,000 KW WEMCO CW Impulse Reaction, new equivalent in vital areas 60/3/2300/1800. (Economy 13#). Surface or jet condenser complement available.

E. 2—5000 KW (7200 KVA) WEMCO CW Design Parsons Multiple Expansion Pattern, special inner steel barrel construction. Units completely rebuilt, rebladed thruout by WEMCO. Highly approved and vouched for. (Economy 11.5#).

F. 3000 KVA Curtis Lynn 4 stage Bracket Bearing double bucketed 200# 60/3/2300/3600. Surface Condenser equipped. Economy 14.#. Total log operation about 12 months.

G. 2500 KVA Curtis Lynn 4 stage Bracket Bearing double bucketed 200#. 14.5#. Total log operation about 8 months.

H. 2—1000 KW 80% Curtis Lynn 4 stage Bracket Bearing 200# Design Condensing and Bleeder. 60/3/2300/3600. Surface Condenser.

Turbo Units 25 Cycle

I. 15,000 KVA Parsons Multiple Expansion Parallel Flow Design Condensing turbo alternator unit. 25/3/6600/1500. Surface Condenser.

J. 12,500 KVA Parsons Multiple Expansion Parallel Flow Design Condensing Turbo Alternator Unit, 25/3/6600/1500. Surface Condenser.

K. 2—6000 KW 80% PF WEMCO CW Frame Impulse and Reaction Design 25/3/6600/1500. Surface Condenser.

L. 2—3500 KW 80% PF WEMCO CW Frame Impulse and Reaction Design 25/3/6600/1500. Surface Condenser.

Frequency Changer Units

O. 2—3000 KW GE Freaks, 25/3/-11000 to 60/3/2300 or 4000—300 RPM. (See illustration "O").

P. 1—1800 KW 80% PF Freak. 25/3/6600 to 60/3/2400 — 300 RPM.

Q. 5000 KVA WEMCO Freak, 62½/3/2300/750 with 5600 HP 25/3/4000/2300 Motor Self-contained exciters.

R. 2000 KVA WEMCO 62½/3/4100 with 2400 HP 25/3/13200/375 RPM Motor.

M. G.

60 CYCLE

V. 1500 KW 600 volt DC MPC Class 14 with 2400 HP Syn Motor 60/3/4150—360 rev.

25 CYCLE

W. 1500 KW 600 volt DC MPC Class 14 with 2400 HP Syn Motor 25/3/13200—360 rev.

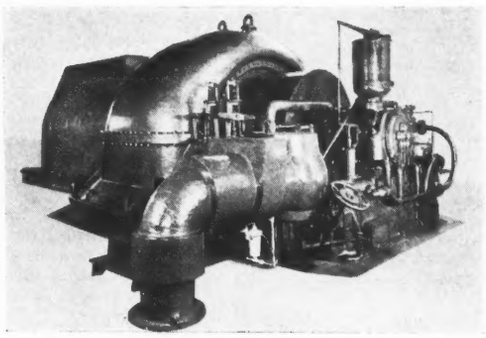


Illustration "A"—For Description see Item "A."

BOILERS

M. 6—1200 HP Stirling 4 Drum Bent Tube Units, 250# ASME Designed and serially identified. Superheater equipped. Gas Fired. Complete going boiler station including removable building and support structure. Short log service. Physical condition 100%.

N. 5—1500 HP Stirling 4 Drum Bent Tube Units, 250# ASME Designed and serially identified. Superheater equipped. Modern Ram Type Taylor Stoker equipped. Coal and ash handling, force and induced draft fan paraphernalia, etc. Removable building and support structure. Short log service. Physical condition 100%.

Rotaries

60 CYCLE

S. 2—3500 KW WEMCO Syn Interpole Compound Wound Booster Type Rotaries 225 rev. 270 V DC 3 or 6 phase. Transformer primary 13,200.

T. 1—1000 KW WEMCO Syn Interpole Compound Wound Booster Type Rotary 600 rev. 250 v. 3 phase. Transformer primary 22,-000.

25 CYCLE

U. 2000 KW 600 Volt DC WEMCO Syn Rotary 25/3 or 6 phase. Transformer complement 9000 v primary.

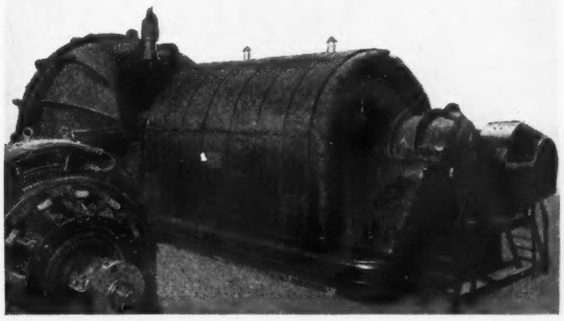


Illustration "B"—For Description see Item "B."

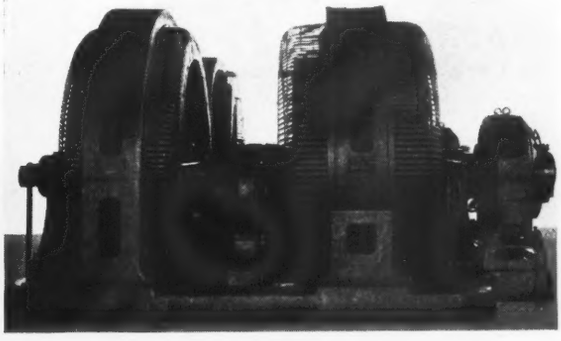


Illustration "O"—For Description see Item "O."

RE-NU-BILT MOTORS GENERATORS TRANSFORMERS LARGE & HEAVY ELECTRIC POWER EQUIPMENT

Thoroughly Tested Before Shipment *And* Guaranteed

RE-NU-BILT BELYEA MOTORS

MORE THAN 50% SAVING

BELYEA CO. INC.
43 HOWELL STREET
JERSEY CITY, NEW JERSEY

FOR SALE: AIR COMPRESSORS

1—610 cu. ft. **I.R.** St. Dr. 100# air.
1—2000 cu. ft. **Wor.** St. Dr. 90# air.
1—7000 cu. ft. **A-C** St Dr 90# air.

STEAM PUMPING ENGINES

1—**Wor. Cr.** Com. C&F 1½ mgd Meyer Valve Gear.
1—**A-C 4 mgd** C&FW Cr. Com. Opp. Type Cond. 12-28x13x24.
1—**Snow** 6 mgd C&FW Cr. Com. Opp. Type Cond. 20-40x14¾x36.
2—**Snow** 10 mgd C&FW Cr. Com. High Duty Opp. Cond. 27x60x17x42.
1—10 mgd **DeLaval** St. Turb. Cent. pump 200' head.
All pumps with water wks. type cond.

STEAM TURBO GENERATOR

1—937 **KVA** 3600 RPM 3-60-2300 Whse.

BIRCH MANUFACTURING COMPANY
1521-1523 Sedgwick St. Chicago, Ill.

TURBINE GENERATOR UNITS
3 Phase 60 Cycle 240/480/600/2400 Volts

2500 KVA GENERAL ELECTRIC condensing, 150-200 lbs. with surface condenser
1875 KVA ALLIS CHALMERS condensing, 150-200 lbs. with surface condenser
1250 KVA ALLIS CHALMERS non-condensing, 125-150 lbs.; 0-6 lbs. back pressure
940 KVA WESTINGHOUSE condensing, 150-200 lbs. with jet condenser
375 KVA WESTINGHOUSE non-condensing, 100-200 lbs.; 0-15 lbs. back pressure

ENGINE GENERATOR SETS
3 Phase 60 Cycle 240/480/600/2400 Volts

750 KVA WESTINGHOUSE-SKINNER Uniflow, 150-200 lbs.; 0-5 lbs. back pressure
500 KVA GENERAL ELECTRIC-SKINNER Uniflow, 120-130 lbs.; 0-5 lbs. back pressure
438 KVA BURKE-AMES Vertical Uniflow, 125-150 lbs.; 0-6 lbs. back pressure
375 KVA GENERAL ELECTRIC-SKINNER Uniflow, 125-160 lbs.; 0-5 lbs. back pressure
210 KVA GENERAL ELECTRIC-AMES Uniflow, 150-175 lbs.; 0-5 lbs. back pressure

ENGINE GENERATOR SETS
125 Volts Direct Current

350 KW BURKE-AMES Vertical Uniflow, 125-150 lbs.; 0-6 lbs. back pressure
125 KW GENERAL ELECTRIC-SKINNER Uniflow, 115-175 lbs.; 0-15 lbs. back pressure

MOTOR GENERATOR SETS
3 Phase 60 Cycle 2300 Volts

600 KW ALLIS CHALMERS synchronous, 250 volts D.C.; 900 RPM
500 KW GENERAL ELECTRIC synchronous, 250 volts D.C.; 720 RPM
500 KW WESTINGHOUSE synchronous, 600 volts D.C.; 720 RPM
150 KW GENERAL ELECTRIC synchronous, 250 volts D.C.; 900 RPM

This is a partial list. Send us your inquiries.

THE NATIONAL POWER MACHINERY CO.
1921 SCRANTON RD. CLEVELAND, OHIO

WANT QUICK DELIVERY?

300 KW **Skinner Uniflow** 480 or 2300 volt. Side crank. #10415. Used nominally. Fine shape.
200 KW **Skinner Uniflow** 220/440 volt, 19x20 engine 225 rpm. With exciter & switchboard.
240 HP 200 KVA **Fairbanks Morse Diesel Generator.**
180 HP **Fairbanks Morse** 3 and 6 cyl. **Diesel Units.**
120 HP Atlas 6 cyl. **Diesel Power Unit.** Clutch.
2—80/150 HP **Buda Gas-Gasoline or Oil Engines.**
3—1200 HP **McIntosh Seymour** 8 cylinder **Diesels.**
48 HP **Cummins** 4 cyl. 1200 rpm **Diesel.** Like new.
80-100-200-300-500 to 840 HP **Fairbanks Diesels.**
150 HP **Casey Hedges Scotch Marine Boiler.**
3—778 HP **B & W** 200# **Boilers.** With Stokers.
2—500 HP **Heine** 200# Straight tube **Boilers.**
1—600 HP **Edgemoor** 200# Water tube **Boiler.**
200 KW to 10,000 KW **Steam Turbine Generators.**
3—333 KVA 1/60/2300 to 115/230 V. **Transformers.**

All Types Good Equipment — Bought and Sold

Mississippi Valley Equipment Co.
507 Locust St., St. Louis, Mo.
Also Hoists, Derricks, Cranes, Tanks, Steel Sheet Piling, Boilers, Motors, Compressors

---

Water Tube Boilers—B. & W. Type

4—1250 H.P. Babcock & Wilcox Cross Drum Water Tube Boilers 350# pressure with B.&W. Chain Grate Stokers; Superheaters; and Economizers.
Boilers set singly.

For details and price write to—

ARCHER & BALDWIN, INC.
75 West St., New York, N. Y.
Tel.—BOwling Green 9-9275—9276

F-M DIESEL ELECTRIC PLANT
300 HP, 257 RPM, 460 V.

C-B Diesel Elec Plant	50 HP-240 V.
5 Steam Engines	75-600 HP
Motors	75-200 HP
Air Compressors	20-1600 cfm

Other power equipment

W. A. SCHUERMAN, Consulting Engineer
16 Cannon Street Poughkeepsie, N. Y.

GENERATOR

1—180 K.W., General Electric, A.C., 3 phase, 60 cycle, 240 volt, 720 RPM, Generator, with belted exciter and slide rails, F.O.B. Brooklyn, N. Y.

NAGER ELECTRIC COMPANY, Inc.
426-8 Broadway Brooklyn, N. Y.

FOR SALE

ELECTRIC SKIP HOIST

Beaumont; 90 ton hopper with gate for truck loading; in good condition. Complete information on request.

ORANGE MEMORIAL HOSPITAL
Orange, N. J.

Two - 1500 KW
Motor Generator Sets
Available for Immediate Shipment

1500 KW, 250 volt, compound wound, 514 RPM, 3 phase, 60 cycle, synchronous Westinghouse motor generator sets complete with generator control panels and motor starting equipment. Excellent condition.

For complete details write or wire to

The Electric Generator & Motor Company
4501 Hamilton Ave., Cleveland, Ohio

BARGAIN

MOTOR GENERATOR SET

75 KW, 125 volts DC, General Electric three bearing motor generator set with 115 HP, 3 phase, 60 cycle, 1200 RPM, squirrel cage motor.

FREQUENCY CHANGER

5 KW Louis Allis, 120 cycles, 3 phase, 60 cycle, driven by a 220/440 volt, 3 phase, 60 cycle motor.

THE MOTOR REPAIR & MFG. CO.
1556 Hamilton Ave. Cleveland, Ohio

AMOSKEAG LIQUIDATION

Power Plant Equipment, Pumps, Motors, Etc.

All in good condition—mostly in place as operated by this great textile concern

OFFERED FOR SALE BY OWNERS

TURBINES

1 3750 KVA Westinghouse Turbo Generator Unit with Condenser, Switchboard, and all Appurtenances.
1 5250 KVA Allis Chalmers Turbo Generator Unit Complete.

AIR COMPRESSOR

1 Ingersoll Rand 2 Stage, Class C. Compressor. 2542 Cu. Ft. Piston Displacement, 85 lb. Air Pressure.

MOTORS

550 Volt and 2200 Volt General Electric Motors, 25 HP to 200 HP.

PUMPS

1 1500 Gal. per Minute DeLaval Centrifugal Pump with 200 HP Motor.
1 2500 Gal. per Minute DeLaval Centrifugal Pump with 300 HP Motor.
1 1500 Gal. per Minute Gould Pump with 150 HP Motor.
2 DeLaval Centrifugal Pumps 4000 gals. per minute with 300 HP Motors.
1 2000 Gal. per Minute Worthington Turbine Pump with 200 HP Motor

All above Pumps on Foundation and running until September 8 of this year when replaced by city water service.

Send All Inquiries to

AMOSKEAG INDUSTRIES, Inc.
Attention: ERNEST T. KIMBALL Manchester, New Hampshire

★

WE OFFER
FOR SALE

MERCURY ARC RECTIFIERS

Automatic and Manually operated 1200 KW Brown Boveri complete units. For immediate shipment. Attractively priced.

UNIFLOW ENGINE SET

1—**250 KW Gen. Elec. Ames Uniflow Engine set,** 3 phase, 60 cyc., 480 volts, 200 RPM, direct connected to 22 x 24 engine, with exciter.

TURBO GENERATOR SET

1—**200 KW** 3 phase, 60 cycle, 480 volt, **Allis Chalmers generator** direct connected to a Terry steam turbine 150# steam pressure, 20# back pressure.

ROTARY CONVERTERS

300 to 2000 KW 600 volts, 23 and 60 cyc. Modern Interpole units.

MOTORS AND GENERATORS

1—**G.E. 300 KW** continuous current **Generator,** Type MPC, class 4-300-720 Interpole, volts no load 525, full load 575. Sync. Motor PF-1, Type ATI. Class 10-345, 720, Form C. HP 435, volts 6600, Amp. 30 cyc. 60, with exciter.

1—**G.E. 500 KW** continuous current **generator,** type MPC, Class 4.500-720. Form H, 833 Amp. 550 volt, Motor, P.F. 8. Type ATI. Form C, Class 10-700-720, 700 RPM, 2300 Volts, 175 amps. 60 cyc.

2—**G.E. 425 HP.** synchronous motors, class 10-720, Form C, Type ATI, 720 RPM 6600 volt, 28.4 amp. 60 cyc.

all sizes and types Transformers.

H. E. SALZBERG CO. INC.

9 PARK PLACE, N. Y. C. **Tel. REctor 2--1890-1-2-3**

Established 1898

TRANSFORMERS

1—2 to 3 phase, 75 KVA, General Electric, from 208 volt, 3 phase to 220 volt, 2 phase, practically new, for sum of **$225.00.**

DIESEL INSTALLATION CORP.
of America
327 HEWES ST. BROOKLYN, N. Y.

FOR SALE
STEAM GENERATOR SETS

1—225 K.V.A. 60 cy., 3 ph., 240 volts G.E. Alternator. Direct Connected to Corliss Engine.
1—215 K.V.A. Same.
1—30 K.W. 125 volt D.C. Steam Driven Exciter Set.
1—2 Machine G.E. Voltage Regulator.

Independent Electric Machinery Co.
300 So. W. Blvd. Kansas City, Mo.

Recently acquired from the United States Navy

FOUR LARGE DIESEL ENGINES

Manufactured by the Electric Boat Company of New London

Built new in 1933 and they were installed in two of our latest submarines. Specifications follow

Marine Type. Direct Reversing. Bore 15.75, Stroke 18.1105.
NO. OF CYLINDERS—9.
TYPE—4 cycle, Solid Injection Engine. BHP—1535, RPM —435.
Fuel Consumption Full Load .402 lbs. per BHP per hr.
Minimum Air Starting Pressure 150 lbs. sq. in.
Lowest idling speed—100 RPM. Average Exhaust Temperature—950 degrees F.
WEIGHT—Approximately 40 tons. LENGTH—21', WIDTH—4' 8", HEIGHT—9'.

Over $100,000.00 in new parts for these engines

Very Desirable for Any Type of Marine Installation or Stationary Power Unit. Actually Used Less Than 1000 Hours

BROOKLYN CONTRACTORS MACHINERY EXCHANGE, INC.

1415 Bergen Street **Phone: PResident 3-7946** **Brooklyn, New York**

ELECTRIC GENERATOR and MOTOR CO.

E&M Established 1900

OUTSTANDING MONEY SAVING VALUES in Modern, Rebuilt Electrical Equipment

. . . . . .

250 Volt Synchronous Motor Generator Sets

1—100 KW, General Electric, 1200 R.P.M.; Type RC Generator, Type ATI Motor
1—150 KW, General Electric, 1200 R.P.M.; Type MPC Generator, Type ATI Motor
2—150 KW, Allis-Chalmers, 1200 R.P.M.
1—200 KW, General Electric, 1200 R.P.M.; Type MPC Generator, Type ATI Motor
1—360 KW, General Electric, 1200 R.P.M.; Type MPC Generator, Type ATI Motor

Synchronous Motors

	H.P.	P.F.	SPEED	MAKE	TYPE
4—	50	0.8	600	G.E.	TS
	55	1.0	1200	E.M.	
2—	75	0.8	1200	Wagner	FW
2—	75	1.0	1800	G.E.	TS
	75	1.0	900	G.E.	ATI
3—	75	0.8	450	G.E.	TS
2—	100	0.8	900	Columbia	
2—	125	0.8	900	G.E.	TS
	200	0.8	1200	A.C.	
	225	1.0	450	E.M.	
2—	225	1.0	300	G.E.	TS
	250	0.8	600	G.E.	TS
	375	0.8	450	West.	
2—	600	1.0	720	C.W.	
2—	700	0.8	720	G. E.	ATI
	760	1.0	450	West.	

Adjustable Speed 230 Volt D. C. Motors

H.P.	SPEED	MAKE	TYPE
3—100	320/850	West.	SK
3—125	450/1000	West.	SK
4—150	320/850	West.	SK
6—250	275/690	West.	QM

We Specialize in

A.C. and D.C. Motors, Motor-Generator Sets, Oil and Air Circuit Breakers, Instruments, Meters, Relays, Feeder Panels, Switchboards, Standard and Special Automatic Controls for A.C. and D.C. Motors.

. . . . . .

The above items are but a small part of our complete stock of rebuilt electrical equipment. For quick reference on any of your needs, we suggest you write for a copy of our 24-page Stock List No. 1620.

ELECTRIC GENERATOR & MOTOR CO.
4501 Hamilton Ave. Cleveland, Ohio

Boilers-Generating Units

(1) 390 & (2) 258 H.P. **Union Iron Works, water tube boilers,** 178/200#, set 10' high over Detroit forced draft, under feed, side dump stokers, soot blowers, Copes feed water regulators, draft gauges, flow meters, all piping & valves, stoker engine & blower.
(2) 230 H.P. **Babcock & Wilcox boilers** 200#, Jones stokers, soot blowers, stack.
(1) 50 ton (self contained) **coal hopper.**
(1) **Boiler feed water treating plant.**
(1) 156 KVA, (4) valve non-releasing **Corliss engine unit,** 3/60/240, board & direct connected exciter.
(1) 220 KVA, (4) valve releasing **Corliss engine unit,** 2 or 3/60/240, board & direct connected exciter.
(4) 7"x4½"x10" **"Burnham"** simplex, double acting, brass fitted, piston pattern, **steam pumps,** like new, two pumps have water sealed piston rod.

H. P. BREARLEY
3423-91st Street, Jackson Heights, N. Y.

AIR COMPRESSORS

Direct Connected Synchronous Motor Driven
1—944 cu.ft. **INGERSOLL-RAND,** XRE, 440/3/60
1—752 cu.ft. **SULLIVAN,** WN3, 220/440/2200/3/60

THE O'BRIEN MACHINERY CO.
115 N. THIRD ST., PHILA., PA.

From the

LIQUIDATION

of the Former

WARR-PENN REFINING PLANT

WARREN, PA.

1—Union
2—Oil City
} 150 HP Horizontal Return, Tubular **Boiler,** 160 lbs. Pressure, examined July 30, 1939. All with Huber Automatic **Stokers.**

1—**Feed Water Heater.**

2—37½ K.V.A. Westinghouse **TRANSFORMER.**

2—150 K.V.A. G. E. **TRANSFORMER** type H. form KR, 60 cycles, voltage rating 6900/11950 Y to 230/460.

Steam Engines
Pumps
Air Compressors
Tanks
Refrigerating Units

All in excellent condition.

Associated Metals & Minerals Corp.

40 Rector Street New York, N. Y.

ENGINE GENERATOR UNITS

60 KVA WESTGH. 3 ph., 60 cy., 440/220 V., 300 RPM generator direct connected 10"x12" AMES automatic engine, 130-150# pressure, 5# back pressure. New 1922.

90 KVA G.E. 3 ph., 60 cy., 2300 V., 277 RPM generator direct connected 13"x14" AMES Unaflow engine, 140-175# pressure, 5# back pressure. New 1921.

100 KVA ELECTRIC MACHINERY 3 ph., 60 cy., 240/480 V., 277 RPM generator direct connected 14"x14" AMES Unaflow engine, 125-150# pressure, 5# back pressure. New 1920.

100 KW G.E. 250 V., 250 RPM direct current generator direct connected 15"x16" SKINNER Unaflow engine, 125-140# pressure, 5# back pressure. New 1919.

125 KVA G.E. 3 ph., 60 cy., 240 V., 225 RPM generator direct connected 15"x17" CHUSE 4-valve engine, 125# pressure, 5# back pressure.

125 KVA G.E. 3 ph., 60 cy., 220/440 V., 257 RPM generator direct connected 15"x15" SKINNER counterflow engine, 100-125# pressure, 5# back pressure—completely rebuilt.

150 KVA G.E. 3 ph., 60 cy., 2300/550/440/220 V., 227 RPM generator direct connected 16"x18" AMES Unaflow engine, 150-175# pressure, 5# back pressure. New 1921.

219 KVA G.E. 3 ph., 60 cy., 2300/440/220 V., 200 RPM generator direct connected 15"x24" NORDBERG Unaflow engine, 150-200# pressure, 0-10# back pressure. New 1919.

250 KVA WESTGH. 3 ph., 60 cy., 480 V., 200 RPM generator direct connected 21"x22" HARRISBURG-FLEMING 4-valve engine, 125-150# pressure, 5# back pressure.

312 KVA WESTGH. 3 ph., 60 cy., 2300/550/440/220 V., 200 RPM alternating current generator—NEW—(less engine).

375 KVA ALLIS 3 ph., 60 cy., 2300/440/220 V., 200 RPM generator direct connected 20"x24" NORDBERG Unaflow engine, 150-200# pressure, 0-20# back pressure. New 1926.

500 KVA IDEAL 3 ph., 60 cy., 240 V., 400 RPM three-bearing belted type generator with direct connected exciter—(less engine).

YOUR INQUIRIES SOLICITED FOR FIRST CLASS USED POWER PLANT EQUIPMENT

UTILITIES ELECTRICAL MACHINERY CORPORATION

406 National City Bank Bldg. Cleveland, Ohio

Synchronous Motor

Ready for Shipment
Condition Guaranteed

300 H.P. General Electric, type HTB, 3 phase, 60 cycle, 2200 volt, 600 RPM with direct connected excitor and starting equipment.

MACHINE TOOLS
BOILERS ELECTRIC MOTORS

DELTA EQUIPMENT CO.

148 N. 3d St. Phila., Pa.

MTR. GENERATORS — ROTARY CONVERTERS

250/275 V.-D.C. and 3-60-2300 V.-A.C.

2—300 KW GEN. ELEC. MPC-ATI
4—200 KW RIDGWAY ELLIOTT
1—100 KW WESTGHSE SK-G
1— 50 KW RIDGWAY ELLIOTT
1—300 KW ALLIS CHAL'S SCC
1—200 KW GEN. ELEC. HCC
1—150 KW WESTINGHOUSE
1—100 KW GEN. ELEC. TCC

JOHN D. CRAWBUCK CO. 1406 EMPIRE BLDG. PITTSBURGH, PA.

PENN ELECTRICAL ENGINEERING CO.
SCRANTON, PA.

A.C.-D.C. MOTORS—
1—500 H.P.

TRANSFORMERS
PUMPS

WIRE, WRITE, PHONE YOUR REQUIREMENTS

DIESEL ENGINES

1— 75 H.P. Buda, Automotive Type
1—120 H.P. Atlas Imperial Air starting
1—170 H.P. Busch-Sulzer Unit
1—200 H.P. Atlas Imperial Air starting

GENERATORS

1—125 K.W. Ft. Wayne AC Generator
1—150 KVA Crocker Wheeler
1—200 K.W. Westinghouse AC Generator
1—250 K.W. Westinghouse AC Generator
Large stock of reconditioned motors, generators, trolley locomotives, and combination locomotives.

Write for Bulletin

Morse Bros. Machinery Company

P.O. Box 1708 Denver, Colorado

BOILERS

Buy Now — and Save Money!

All Makes, Sizes and Pressures

NEW and USED!

J. F. DAVIS

122 S. Michigan Ave. CHICAGO

4—750 HP **Kidwell Water Tube Boilers**
2—1500 KW. 2300 Volt, **Allis-Chalmers Turbo-Generators,** with Jet Condensers
1—750 KW. 2300 Volt, **Allis-Chalmers Turbo-Generator,** Mixed Pressure Machine, with Jet Condenser
1—20 KW. **G.E. Motor Generator,** 60 Volt, 30 HP. 440 Volt Motor
1—75 KW. **G.E. Motor Generator,** 250 Volt, 100 HP. 2200 Volt Motor
3—25 HP. **G.E.** 2200 Volt, 1160 RPM, 60 cy.
3—30 HP. **G.E.** 2200 Volt, 1160 RPM, 60 cy.
17—500 KVA **G.E.** 22000/600 v., 3 ph., 60 cy.

PENSACOLA COMPANY

1100 Fourth Street, Berkeley, California

2—360 HP YVA **Fairbanks Morse Engines** dir. connected to 300 KVA Generators.
3—300 HP YV **Fairbanks Morse Engines** dir. connected to 250 KVA Generators.
2—200 HP-6-75 HP Y.V. **Fairbanks Morse.**
6—75 HP YV **Fairbanks Morse Oil Engines.**
3—100 and 3—140 **DeLa Vergne Oil Engines.**
1—150 HP **Erie Ball Steam Engine** direct connected to 96 KW Generator.
1—1500 KW; 1—750 KW; 1—375 KW **Turbines** A-1 condition.
Motors, Generators, Oil and **Gas Engines. Compressors** all sizes

For Full particulars write

A. C. ASKEW

Whittier Sta Box 73 Tulsa, Okla.

NEW AND USED PIPE FOR EVERY PURPOSE

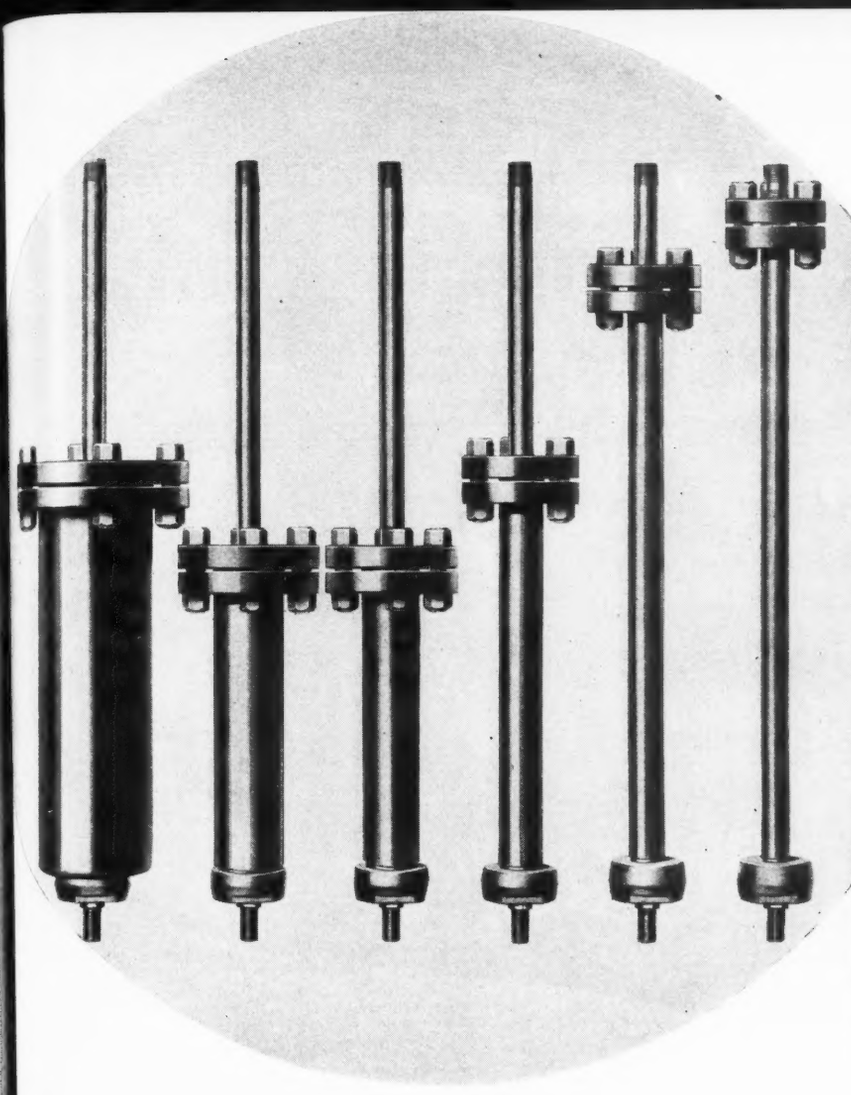
Large stocks carried everywhere for spot shipment.

JOS. GREENSPON'S SON PIPE CORP.

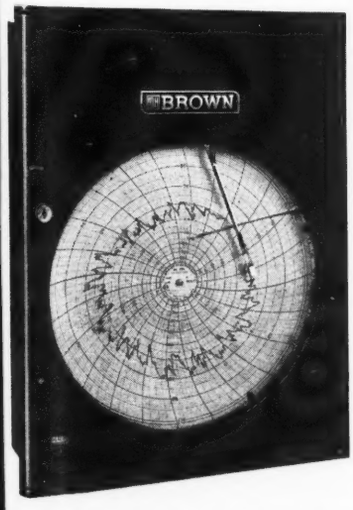
National Stock Yards (St. Clair Co.) **Ill.**

Over 23,800 other subscribers in the Power Plant Field will see this page—

Then isn't this the logical place to advertise any business wants you may have of interest to Power Plant men? Employment — Business — Equipment Opportunities, etc. etc.



Range-Changing Easy, Quick, Inexpensive!



Brown Recording Flow Meter with Automatic Recording Planimeter and Integrator; in modern rectangular case styled by Henry Dreyfuss.

It is often necessary for power plants to change the range of flow meters to meet different operating conditions. With the Brown Electric Flow Meter Body such a change can be made quickly, easily and cheaply by simply substituting a new range tube of proper size in place of that originally furnished.

Six interchangeable range tubes are available that cover a span of 20" to 200" of water (full scale deflection) which permits changing the range without disturbing the orifice or shutting down the line.

The Brown Meter Body is easy to clean—it can be taken apart, cleaned and reassembled with a 10" wrench in less than 30 minutes.

Highest accuracy is assured by the Inductance Bridge Principle of Operation. Available in two types—one for working pressures up to 2,500 lbs., tested at 5,000 lbs.—the other for pressures up to 5,000 lbs., tested at 10,000 lbs.

Send for complete information about this New Brown Meter Body—write for Catalog No. 2006 describing many other advantages of Brown Electric Flow Meters. THE BROWN INSTRUMENT COMPANY, *a division of Minneapolis-Honeywell Regulator* Co., 4490 Wayne Avenue, Philadelphia, Pa. Offices in principal cities. Toronto, Canada: 117 Peter Street—Amsterdam-C, Holland: Wijdesteeg 4—England: Wadsworth Road, Perivale, Greenford, Middlesex—Stockholm, 16, Sweden, Nybrokajen 7.

BROWN FLOW METERS *and* MINNEAPOLIS-HONEYWELL CONTROL SYSTEMS

ADVERTISERS' INDEX

Where an * appears after a name the advertisement does not appear in this issue, but appeared in preceding issues.

Air-Maze Corp....190
Allen-Sherman-Hoff....Second Cover
Allis-Chalmers Mfg. Co....19, 113, 119, 214
American Blower Corp....200-201
American Brass Co....127
American Chimney Corp....199
American Chain & Cable Co....40–41
American District Steam Co....180
American Engineering Co....*
American Metal Hose Branch....*
American Pulverizer Co....*
American Radiator & Standard Sanitary Corp....200-201
Anderson Co., V. D....156
Armstrong Machine Works....14–15
Arrowhead Iron Works....*
Atlas Valve Co....*

Babbitt Steam Specialty Co....152
Babcock & Wilcox Co....*
Bailey Meter Co....16–17
Baldwin-Hill Co....146
Bartlett Hayward Div....158
Belmont Packing & Rubber Co....*
Bendix Aviation Corp....*
Betz, W. H. & L. D....125
Biddle Co., James G....132
Blackmer Pump Co....192
Blaw-Knox Co....*
Boiler Tube Co. of America....141
Borg Warner Corp....195
Brassert & Co., H. A....*
Brownell Co....186
Brown Instrument Co....211
Buffalo Forge Co....189
Buffalo Pumps....183
Bussmann Mfg. Co....34-35
Byers Co., A. M....54

Carborundum Co....*
Carey Co., Philip....*
Cash Co., A. W....182
Chaplin Fulton Mfg. Co....192
Chapman Valve Mfg. Co....*
Chase Brass & Copper Co....137
Chicago Bridge & Iron Co....*
Chicago Pneumatic Tool Co....*
Cities Service Oil Co....159
Clarage Fan Co....179
Cochrane Corp....22–23
Columbia Casualty Co....*
Columbia Electric Mfg. Co....192
Combustioneer Division Steel Products Engineering Corp....*
Combustion Engineering Co....8–9
Coppus Engineering Corp....*
Corning Glass Works....111
Crane Co....29
Cutler-Hammer, Inc....Back Cover

Dart Mfg. Co., E. M....188
Davis Regulator Co....*
Dearborn Chemical Co....*
De Laval Separator Co....*
De Laval Steam Turbine Co....50, 180
Deming Co....194
Detroit Stoker Co....*
Diamond Power Specialty Corp....6–7

Eagle Picher Lead Co....172
Edge Moor Iron Works....*
Edward Valve & Mfg. Co....115
Electric Machinery Mfg. Co....10–11
Electric Storage Battery Co....*
Elgin Softener Corp....164
Elliott Co....4–5 49
Erie Electric Co....199

Fairbanks Co....197
Fedders Mfg. Co....*
Fisher Governor Co....*
Flynn & Emrich Co....*
Foster Engineering Co....*
Foster Wheeler Corp....18
Foxboro Company....185
France Packing Co....148
Frick Company....197
Fuller Company....*

Gardner-Denver Co....36
Garlock Packing Co....45
General Electric Co....48, 167, 175
Globe Steel Tubes Co....191
Goetze Gasket & Packing Co....213
Golden-Anderson Valve Specialty Co....134
Goodyear Tire & Rubber Co....*
Graver Tank & Mfg. Co....*
Greene Tweed & Co....176
Grinnell Co....27
Gulf Oil Corporation....143
Gulf Refining Co....143

Hamilton Co., E. A....199
Harrisburg Steel Corp....*
Harrison Radiator Div....*
Haynes Stellite Co....39
Hays Corp....154
Henszey Co....150
Hercules Float Works....148
Hilliard Corp....*
Hoffman Specialty Co....*
Homestead Valve Mfg. Co....*

Ingersoll-Rand Co....173
International Heating & Ventilating Exposition....*
International Nickel Co....26, 131
Iron Fireman Mfg. Co....165

Jarecki Mfg. Co....186
Jenkins Bros....120–121
Johns Manville....28, 171
Johnson Service Co....142
Johnston & Jennings Co....33
Jones & Laughlin Steel Corp....155
Jones Foundry & Machine Co., W. A....178

Keasbey & Mattison Co....47
Keeler Co., E....*
Kellogg Co., M. W....*
Kennedy Valve Mfg. Co....162
Koppers Coal Co....157
Koppers Co....157–158

Leavitt Machine Co....*
Leeds & Northrup Co....*
Leitch Co., Arthur S....198
Linde Air Products Co., The....*
Link Belt Co....3
Lunkenheimer Co....153

Manhattan Rubber Mfg. Division Raybestos-Manhattan, Inc....42
Manzel Brothers Company....196
Marley Co....*
Mason-Neilan Regulator Co....136
Maxim Silencer Co....152
McGraw-Hill Book Co....184, 188
Midwest Piping & Supply Co....163
Minneapolis-Honeywell Regulator Co....211
Moore Steam Turbine Corp....Third Cover
Morse Chain Co....195
Murray Iron Works Co....166

PROFESSIONAL SERVICES 198

SEARCHLIGHT SECTION

(Classified Advertising)

Classification — Page

BUSINESS OPPORTUNITIES....202
EMPLOYMENT SERVICES....202
POSITIONS VACANT....202
POSITIONS WANTED....202
SELLING OPPORTUNITIES....202
WANTED TO PURCHASE....202
USED EQUIPMENT....202-210

Amoskeag Industries Inc....208
Andrew-Myerson Corp....206
Archer & Baldwin Co....206-208
Askew, A. C....210
Associated Metals & Minerals Corp....210

Belyea Co., Inc....208
Birch Manufacturing Co....208
Brearley, H. P....209
Brew, Woltman & Co., Inc....203
Brill Equipment Corp....203
Brooklyn Contractors Machinery Exchange Inc....209

Castle, James T....204
Chicago, Electric Co....206
Circuit Breaker Co....206
Continental Salvage & Machinery Corp....202
Crawbuck, John D....210

Davies, J. F....210
Delta Equipment Co....210
Diesel Installation Corp. of Amer....209
Douglass Co., Stephen A....202
Duquesne Electric & Mfg. Co....204

Ebasco Services Inc....202
Electric Apparatus Repair Co....204
Electric Generator & Motor Co....208-209
Electric Service Co., Inc....206
Ellis Co., A. Lee....206
Erie Electric Motor Repair Co., Inc....206

Fletcher Sales Co....206

Greenspon's Son Pipe Corp., Jos....210

Hall & Co., Stephen....204
Hemphill & Co., Inc., J. L....203
Hendricks Electric Motor Service....202
Hunt's Sons, M. J....204

Independent Electric Mchy Co....209
Interstate Power Equipment Co....202

Kirk Co., Inc., Wallace E....204

Land, L. J....205

Mississippi Valley Equipment Co....208
Morse Bros. Machinery Co....210
Motor Repair & Mfg. Co....208

Nager Electric Co....208
National Power Mch. Co....208
Northern Indiana Power Co....206

O'Brien Machinery Co....209
Orange Memorial Hospital....208

Pariser Electric Motor Co., Inc....205
Peerless Laundry....202
Penn Electric Engr. Co....210
Pensacola Co....210
Philadelphia Transformer Co., Inc....204
Power Plant Equipment Co., Inc....203

Rearick, Chas. B....205

Sachsenmeier Co., Geo....204
Salzberg Co., Inc., H. E....209
Scheinert, R....204
Schuerman, W. A....208
Southern Machinery Co....202
Stewart & Co., Paul....207
Stanhope Inc., R. C....205
Superior Electric Mchy. Co....206

Tippins Machinery Co....204

Utilities Electrical Machy. Corp....210

Wilms, Weaver & Co....205
Woodworth, H. A....202

National Aluminate Corp.....117
National Supply Co.....*
National Tube Co.....135
National Valve & Mfg. Co.....187
Naugatuck Mfg. Co.....199
Nicholson & Co., W. H.....150
Nordberg Mfg. Co.....181
Northern Equipment Co.....123

Oakite Products.....192
Ocean Accident & Guarantee Corp.....*

Pacific Pump Works.....*
Peale, Peacock & Kerr.....190
Pennsylvania Pump & Compressor Co.....*
Permutit Co.....*
Philadelphia Gear Works.....*
Photoswitch Inc.....*
Pipe Fabrication Institute.....37
Pittsburgh Coal Co.....194
Pittsburgh Piping & Equipment Co.....147
Powell Co., Wm.....145
Power Piping Division.....*
Power Service Section.....199
Pure Oil Co.....199

Reading Pratt & Cady Div.....40–41
Reeves Pulley Co.....*
Reliance Gauge Column Co.....174
Republic Flow Meters Co.....20–21
Republic Rubber Div.....*
Republic Steel Corp.....38
Research Corp.....168
Rhoads & Sons, J. E.....186
Richardson Scale Co.....196
Ric-Wil Co.....*
Riley Stoker Corp.....92–93
Robins Conveying Belt Co.....46
Rockwell Co., W. S.....*
Roebling's Sons Co., John A.....177
Roto Company.....198

Sarco Company.....*
Scaife & Sons Co., Wm. B.....144
Scovill Mfg. Co.....133
Searchlight Section.....202–210
Shaw Co., Benjamin F.....*
Shell Oil Co.....*
Simplex Valve & Meter Co.....148
Sloan Valve Co.....129
Smith Refractories Co., Sanford C.....199
Smooth-On Mfg. Co.....190
Snap-on Tools Corp.....*
Socony-Vacuum Oil Co.....24–25
Springfield Boiler Co.....151
Squires Co., C. E.....180
Standard Oil Co. of California.....161
Standard Oil Co. (Indiana).....139–140
Standard Pressed Steel Co.....*
Steel & Tubes.....38
Stephens-Adamson Mfg. Co.....*
Sterling Engine Co.....*
Strong, Carlisle & Hammond Co.....184
Sturtevant Co., B. F.....*
Superior Diesel Engine Division.....*
Swartwout Co.....170

Taylor Forge & Pipe Works.....138
Taylor Instrument Co's.....*
Terry Steam Turbine Co.....160
Texas Company.....32
Tide Water Associated Oil Co.....30–31
Timken Roller Bearing Co.....*
Todd Combustion Equipment.....*
Toledo Pipe Threading Machine Co.....178
Trico Fuse Mfg Co.....150
Tripp Metallic Packing Co.....199
Troy Engine & Machine Co.....44
Tube-Turns, Inc.....*

Union Carbide & Carbon Corp.....39
Unit Heater & Cooler Co.....196
U. S. Steel Corp. Subsidiaries.....135

Viking Pump Co.....*
Vogt Machine Co., Henry.....149

Walworth Co.....193
Warren Steam Pump Co.....*
Watson Stillman Co.....146
Western Precipitation Corp.....168
Westinghouse Electric & Mfg. Co.....52–53
Wickwire Spencer Steel Co.....*
Wilson Inc., Thomas C.....176
Worthington Pump & Machinery Corp. 43, Third Cover

Yarnall-Waring Co.....12–13
Youngstown Sheet & Tube Co.....169

G. G. Rides Again!

"Paul Revere had nothing on us when it comes to not sparing the horsepower. Only it's not 'the British are coming,' — it's 'the Gaskets are coming.'

"Seems like nobody ever needs a gasket unless it's in a hurry. And boy — how we run when you whistle. Teletypes start ticking, bells ring, whistles blow, wheels hum, and pronto — gaskets to button up a boiler in Buffalo, or a pipe line in the Panhandle, start rolling.

"It's a crazy business for us — but it's serious business for you when it means getting idle equipment back to work.

"We are lucky to be organized the way we are to supply any gasket type, shape and size, in any combination of materials, on demand, to save your time and money."

Yours, G. G.

THERE'S A GOETZE GASKET FOR EVERY SERVICE

GASKETS FOR — Pipe Flanges; Heat Exchangers; Boiler Tube Caps; Hand Holes and Man Holes; Pumps; Compressors; Engines; Turbines; Pressure Vessels; Drum Plugs, etc.

GASKET TYPES — Corrugated Metal with or without Asbestos; Metallized Corrugated Metal-Asbestos; single or double Jacketed Metal-Asbestos; Corrugated Metal Jacketed; Serrated Metal-plain, Metal Clad or Asbestos Lined; ... Spiral Wound Metal-Asbestos; Perforated; Cross-Ribbed; Solid Metal Rings — washer or special Cross-Section; Woven, Compressed and Wire Mesh. Asbestos Sheet Packing; Stuffing Box Packing.

GOETZE GASKET & PACKING CO., Inc.
10 Allen Avenue, New Brunswick, N. J.
Branch Offices in Principal Cities

Goetze for GASKETS
"America's Oldest and Largest Industrial Gasket Manufacturer"

LESS COST, LESS SPACE MORE GALLONS!

Three BIG Reasons Hundreds of Plants are Switching to Allis-Chalmers Extra-Value SSUnit Pumps!

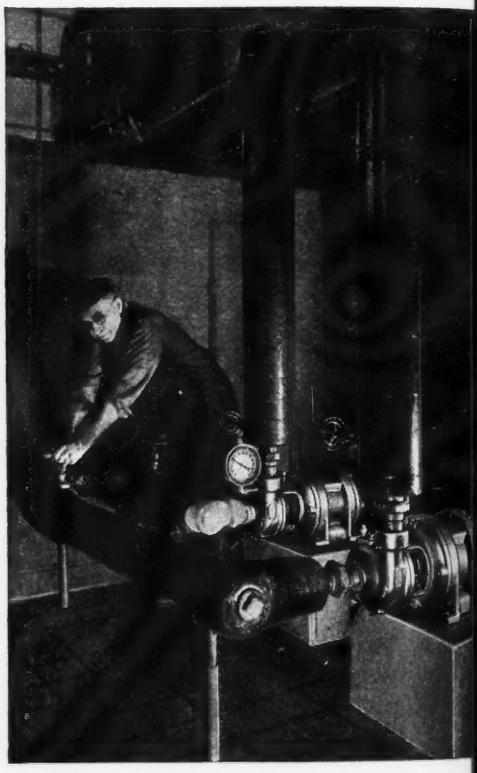
The little pump with the big money-saving performance . . . that's what men in the field say about the sensational SSUnit Pump! And here are the three big reasons they're switching to this low-cost motor-coupled pump . . . originated by the same Allis-Chalmers engineers who designed and built the gigantic turbines at Boulder Dam and Niagara Falls.

LESS COST! Simple design cuts first cost to a new low! Enclosed runner, wearing rings, and shaft sleeves are made of bronze — no chance for rust or excessive wear that runs up maintenance costs! SSUnit Pumps are completely tested before delivery . . . no wasted time or effort . . . they go to work for you the minute they're installed!

LESS SPACE! They set new records for compactness . . . these husky SSUnit Pumps! And they'll operate vertically or practically any way you want them to. That means you can save valuable space in your plant!

MORE GALLONS! You get more gallons with SSUnit Pumps because you get more efficient operation. Actual results in the field prove that new SSUnit Pumps in many cases give more than a 15% greater supply of water than older types of pumps . . . and that more water means more power dollars saved!

But you don't stop there! For coupled to the SSUnit pump is the famous Allis-Chalmers Lo-Maintenance Motor . . . the motor that has proven performance records of beating conditions that many times wreck ordinary motors in a few weeks. There's no "buck-passing" . . . Allis-Chalmers accepts full responsibility for both motor and pump!



PUMPING BRINE IN REFRIGerating system of a large county institution, this SSUnit Pump takes less space, costs less, gives more gallons!

Call the nearest district office today . . . or write direct to Allis-Chalmers. That's the way to get started on real pump savings!

1084

CENTRIFUGAL PUMP DIVISION

ALLIS-CHALMERS

MILWAUKEE·WISCONSIN

90 Years of Engineering Superiority Work for You When You Specify Allis-Chalmers!

TECHNOLOGY DEPT.

PUBLIC LIBRARY
DEC 27 1939
DETROIT

POWER

POWER GENERATION, TRANSMISSION, APPLICATION AND THE ATTENDANT SERVICES IN ALL INDUSTRIES

BUYERS' GUIDE NUMBER

Mid-December, 1939

FEATURING

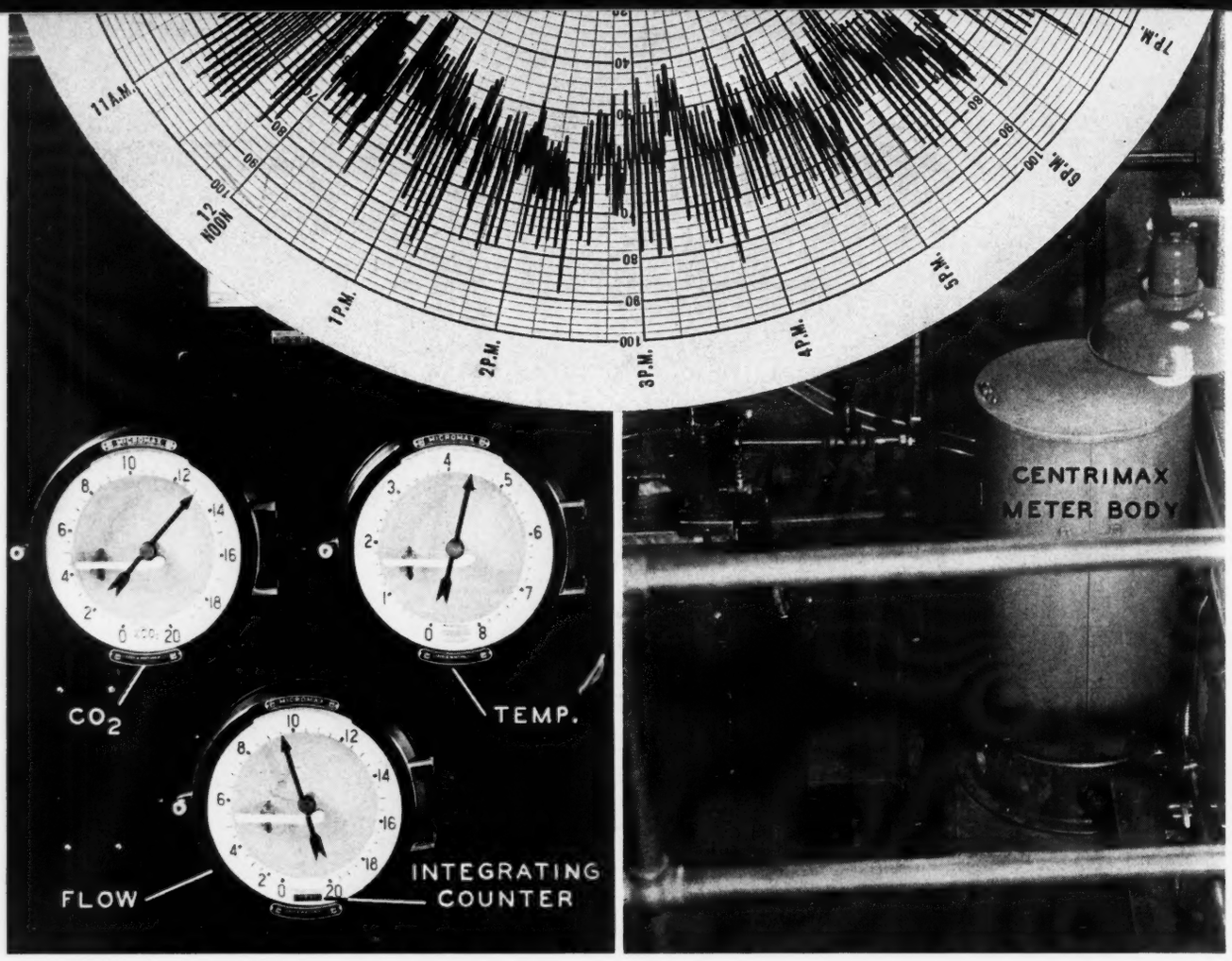
REVIEW OF THE YEAR'S NEW EQUIPMENT
Over 375 "new models" of 1939 — described, illustrated and classified in fourteen equipment groups — PAGE 56

A S M E ANNUAL MEETING REPORT
New ideas of 1939 — resumés of all power papers and discussions, with diagrams and photographs — PAGE 91

NEW CATALOGS AND BULLETINS
To help you bring your files up to date — brief reviews of 400 pieces of manufacturers' literature — PAGE 104

DIRECTORY OF POWER EQUIPMENT AND SUPPLIES
What and where to buy — your quick, convenient reference to 400 power products made by 800 manufacturers — PAGE 155

Power Equipment Reference — Keep it Handy!



In addition to its consumer load, this power plant supplies process steam for the production of water gas. Steam flow varies with such speed, magnitude and frequency that accurate measurement of flow presents an interesting problem. Centrimax solves it.

It Takes CENTRIMAX To Integrate THESE Flow Swings Accurately

Rapidly changing steam flow is hard to measure accurately. When it varies by as much as 50% of capacity as often as every three minutes or so, measurement is really difficult . . . yet, even under these conditions, Centrimax integrates accurately, promptly following every change.

The reason? High speed of response, another of the features inherent in the Centrimax's unique design. Applied to flow, the balance principle employed by Centrimax retains all of its well-recognized superiorities for measuring weight, electrical and other quantities . . . eliminates many sources of error present in other methods. This and other advantages are causing Centrimax to be selected wherever the highest possible accuracy of integration is desired.

The source of this accuracy is direct integration—independent of the recorder. Instead of recording the difference in pressure across the orifice and integrating the record, Centrimax balances differential pressure with the centrifugal force of a flyball system, and integrates by merely counting the flyball revolutions.

Write for Catalog N-28

LEEDS & NORTHRUP COMPANY, 4910 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

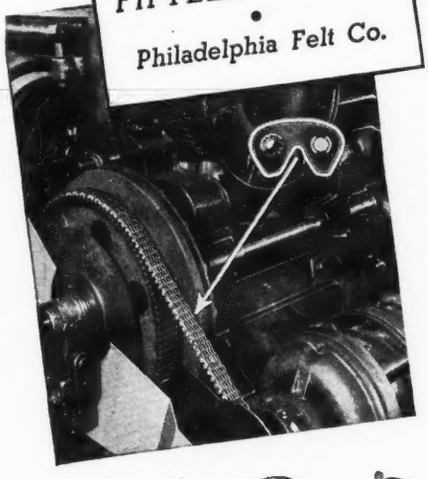
MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

JrlAdN-28-163(3)

POWER (with which are consolidated "Science and Industry," "The Engineer's Review," "The Engineer," and "The Stationary Engineer"), December 15, 1939, Vol. 83, No. 13. Published monthly with an additional Directory number in December, McGraw-Hill Publishing Company, Inc., Publication office, 99-129 North Broadway, Albany, N. Y. Editorial and Executive offices: 330 West 42nd Street, New York, N. Y. Entered as second-class matter August 25, 1936, at Post Office, at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Domestic subscription, U. S., U. S. Possessions and Canada, $3.00 per year. All other countries, $6.00 or 36 shillings per year, U. S. currency or the equivalent, 35 cents per copy.

Silent Chain Performance Facts

CASE HISTORY
Trial of One
Link-Belt
Silent Chain Drive
Results in
Purchase of
FIFTEEN OTHERS
•
Philadelphia Felt Co.



Better Product—Better Operating Conditions with Silent Chain Drives

● When Philadelphia Felt Co., moved part of its operations into new, larger quarters, gear drives on their looms were found to cause excessive noise and vibration. Link-Belt engineers recommended a silent chain drive which upon trial not only eliminated these objectionable conditions but proved so satisfactory that fifteen additional drives of this type have been installed. After a year of operation, the new drives have not only given the smooth, silent operation desired, but their positive, non-slip characteristics are producing a more uniform quality of felt as it comes from the looms. And, because of the cushioning effect of the chain drives, a decided reduction in loom parts requiring replacement or repair has been achieved. Needless to say, this unexpected additional economy has been greatly appreciated.

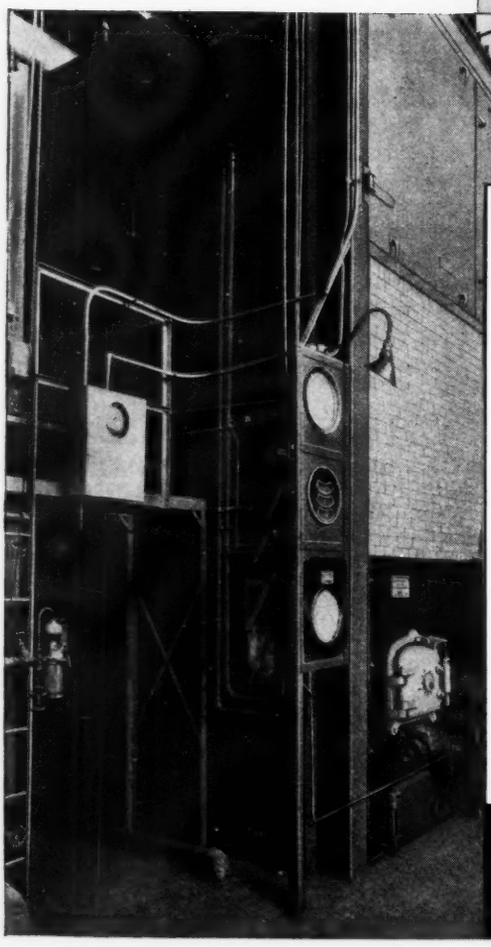
Book No. 125 gives details and engineering data on Link-Belt silent chain drives, explaining their greater efficiency and economy. In many cases they are less costly to install than V-Belt or flat-belt drives; but their outstanding superiority is seen in their year-in, year-out efficient, trouble-free service. Write for Book No. 125, and books on all or any of the Link-Belt positive drives illustrated below.

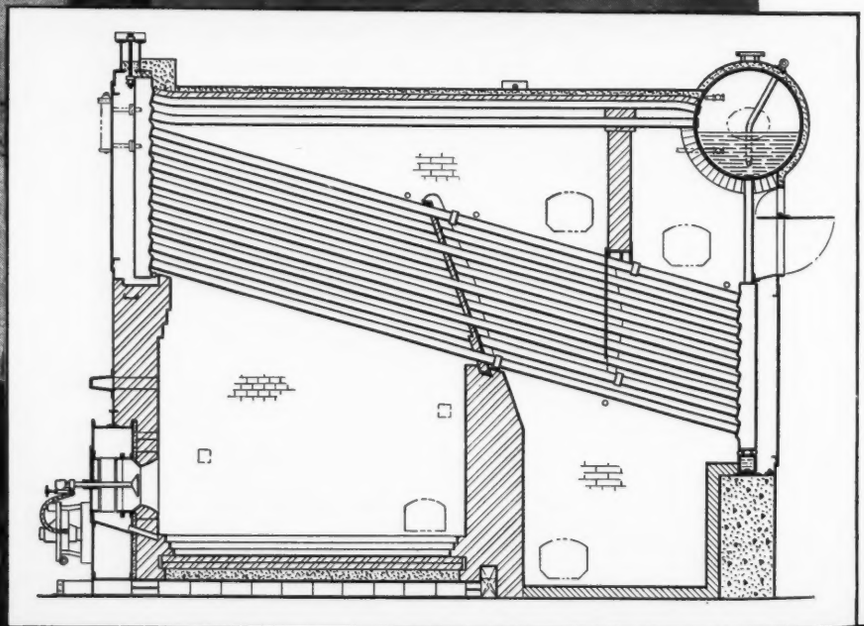
Link-Belt Company, Indianapolis, Philadelphia, Chicago, Atlanta, San Francisco, Toronto, Offices and Distributors in all principal cities. 7881

LINK-BELT

SILVERSTREAK SILENT CHAIN DRIVES

B&W Design 32 Cross-Drum Boiler





BABCOCK &

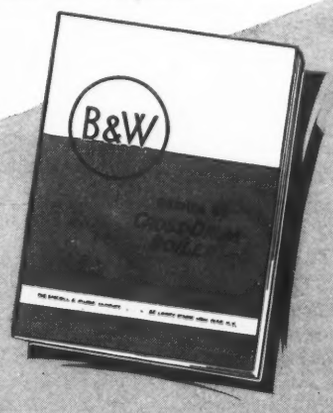
With these Advantages of

Sectional-Header Design

• • • at reasonable cost

- Straight tubes—easy to look through—easy to clean and renew from outside the boiler.
- Standardized, interchangeable tubes reduce unnecessary inventory of spares.
- Long tube life—because the sectional-header construction provides rapid, positive circulation, with minimized cross currents and eddies.
- No staybolts to act as focal points for caustic embrittlement.
- Headers and drums located so that soot and ash cannot settle on them, absorb moisture and cause corrosion.
- Exceptional safety: highly sectionalized pressure parts—seamless steel tubes.
- Low furnace-walls, hence reduced initial cost and low upkeep of brickwork.
- These and other advantages of the B&W Design 32 Boiler are available at a relatively low cost because this boiler is of simple design, and is standardized for economical manufacture. Erection costs are minimized by the flexibility of the design which permits its installation with fewest building changes.
- A new bulletin—G-32—describes this boiler more fully . . . sent on request.

G-169-T



WRITE FOR THIS NEW BULLETIN . . . G-28

WILCOX

85 LIBERTY STREET
NEW YORK, N. Y.

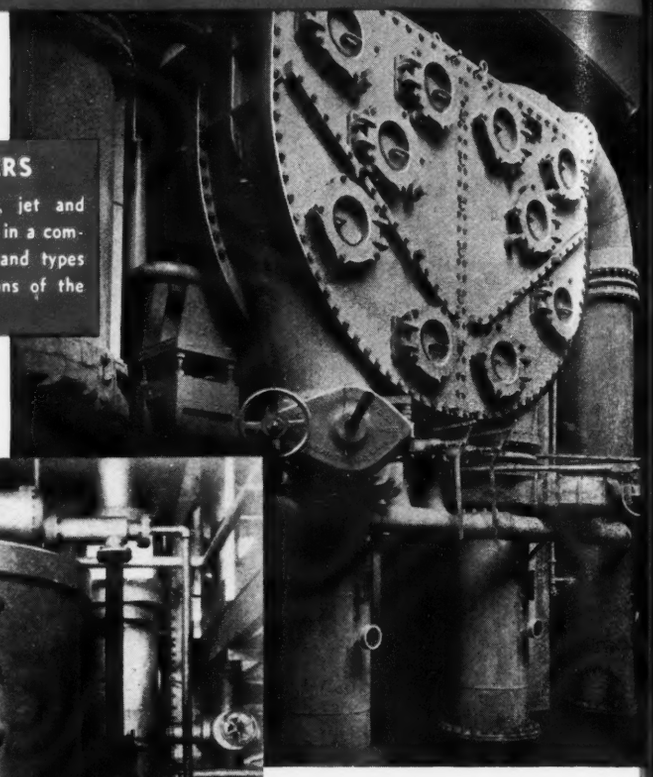
Equipment that builds

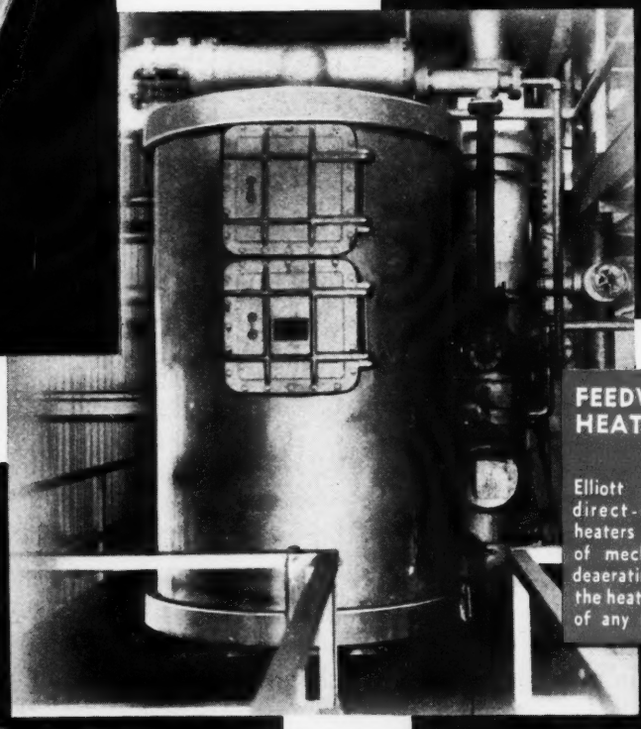
STEAM TURBINE-GENERATORS

Continual development keeps Elliott turbine-generator units in the forefront of progress in design and efficiency. Performance records show their dependability.

CONDENSERS

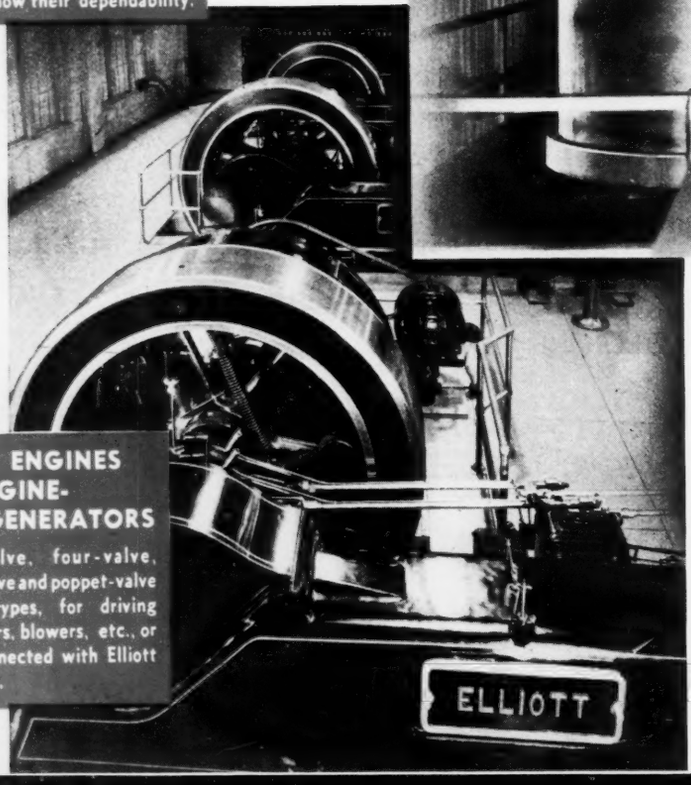
Elliott builds surface, jet and barometric condensers in a complete range of sizes and types to suit exact conditions of the installation.





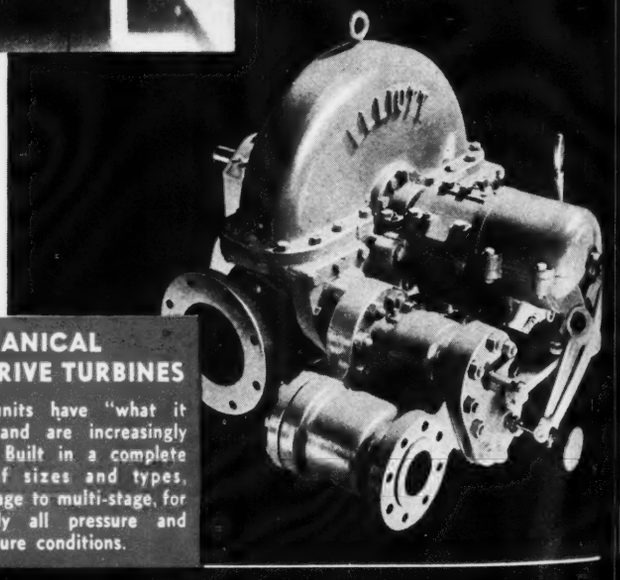
FEEDWATER HEATERS and DEAERATORS

Elliott builds tubular and direct-contact feedwater heaters of the highest type of mechanical construction, deaerating equipment to fit the heat balance requirements of any plant.



STEAM ENGINES and ENGINE-GENERATORS

Single-valve, four-valve, Corliss-valve and poppet-valve uniflow types, for driving compressors, blowers, etc., or direct-connected with Elliott generators.



MECHANICAL DRIVE TURBINES

These units have "what it takes", and are increasingly popular. Built in a complete range of sizes and types, single-stage to multi-stage, for practically all pressure and temperature conditions.

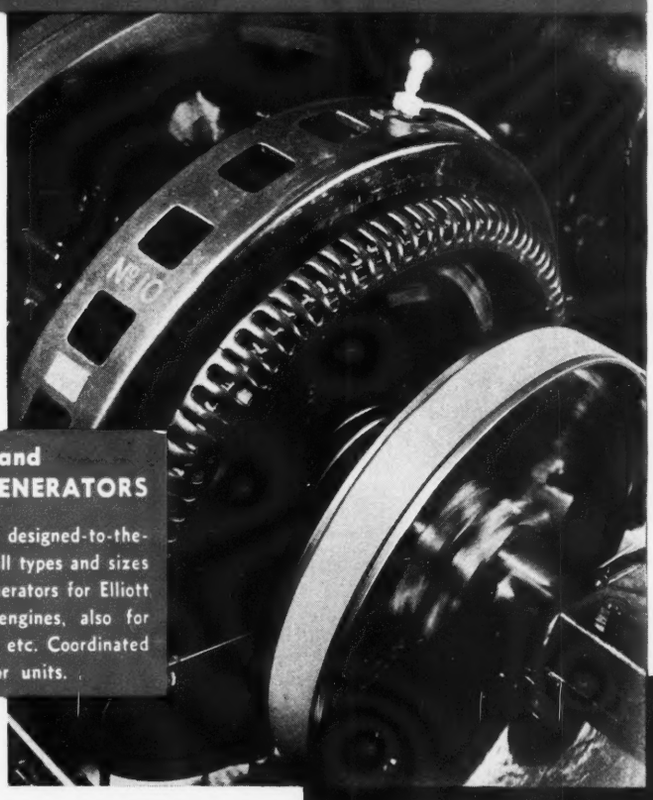
ELLIOTT

reputation ... *for you and for us*

You have to keep the plant running — you must have efficient performance, trouble-free operation, dependability. . . . *We* too have a reputation to sustain, and to do so we build Elliott equipment to the highest possible standards. Your selection of this equipment serves us both.

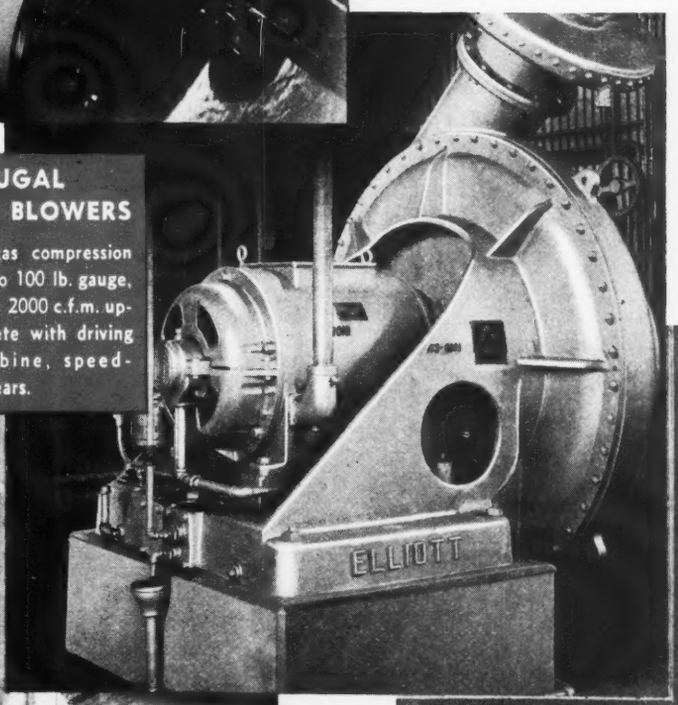
We have never discovered any other way to build the reputation which Elliott products have achieved, except through painstaking care in design and manufacture, and continued interest in performance after sale. Your assurance of a successful installation rests firmly upon this policy.

Literature describing any of the various units shown or listed on these pages, mailed you upon request. Engineering cooperation offered without obligation.



MOTORS and GENERATORS

Elliott builds designed-to-the-job motors, in all types and sizes over 50 hp. Generators for Elliott turbines and engines, also for Diesel engines, etc. Coordinated motor-generator units.



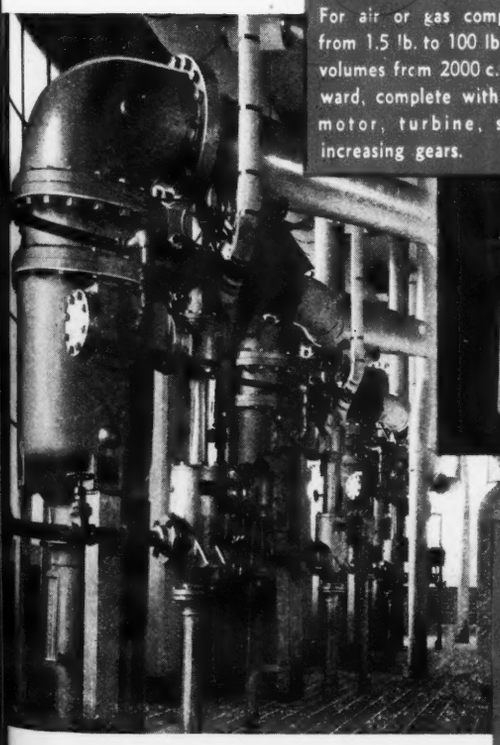
CENTRIFUGAL BLOWERS

For air or gas compression from 1.5 lb. to 100 lb. gauge, volumes from 2000 c.f.m. upward, complete with driving motor, turbine, speed-increasing gears.

Q-1065

POWER PLANT ESSENTIALS

Smaller in size than Elliott major equipment, but vitally important in power plant maintenance. Built with "Characteristically Elliott" care.



STEAM JET EJECTORS

For maintaining vacuum on condensers and industrial processes, a wide range of steam jet ejector equipment is available. Picture shows four three-stage ejectors serving deodorizers.

LAGONDA and LIBERTY TUBE CLEANERS

STRAINERS

DESUPERHEATERS

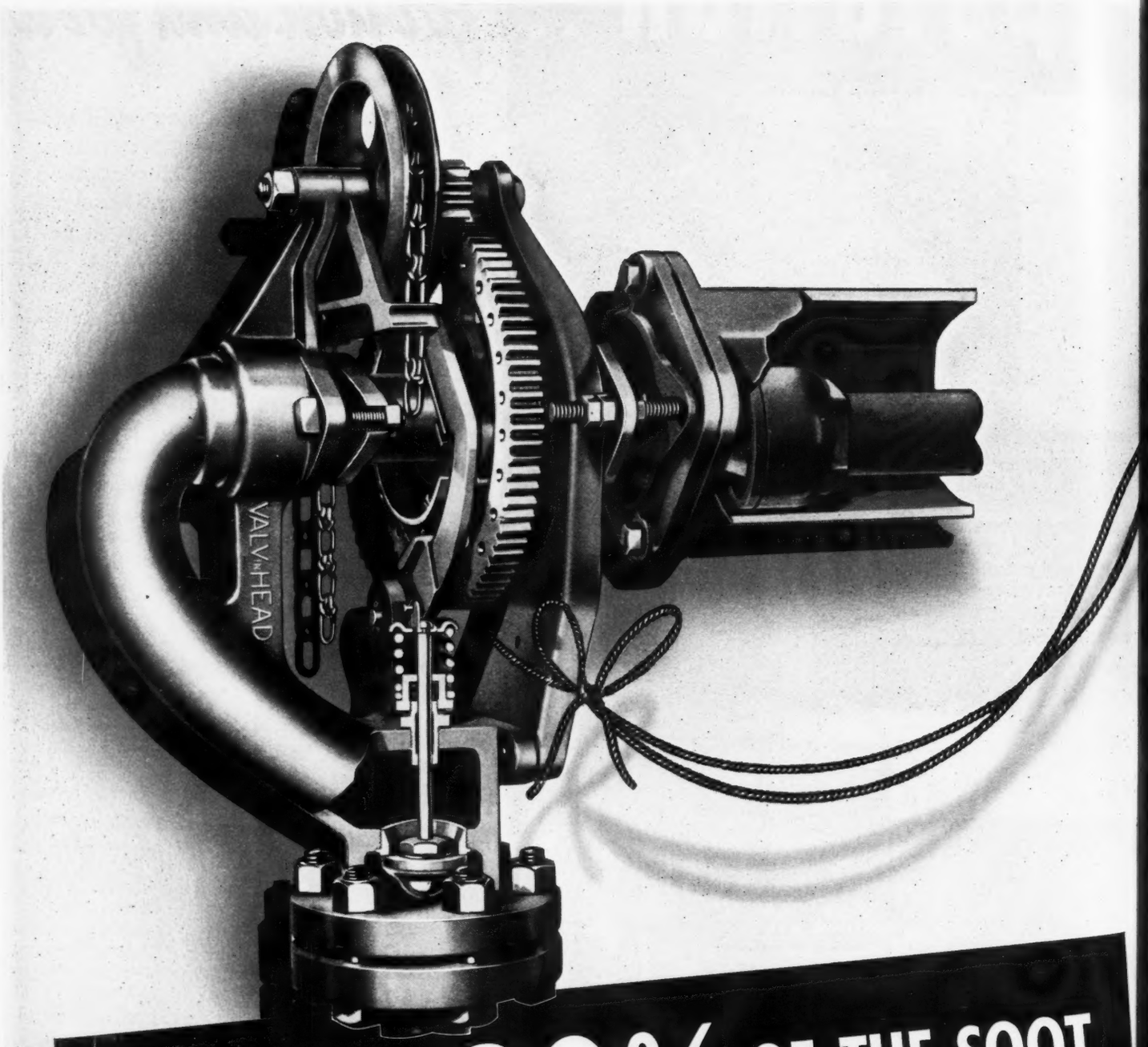
SEPARATORS

NON-RETURN VALVES

COMPANY

WORKS: JEANNETTE, PA.
RIDGWAY, PA. · SPRINGFIELD, O.

District Offices in Principal Cities



MORE THAN 80% OF THE SOOT BLOWERS IN MODERN POWER BOILERS ARE DIAMOND SOOT BLOWERS

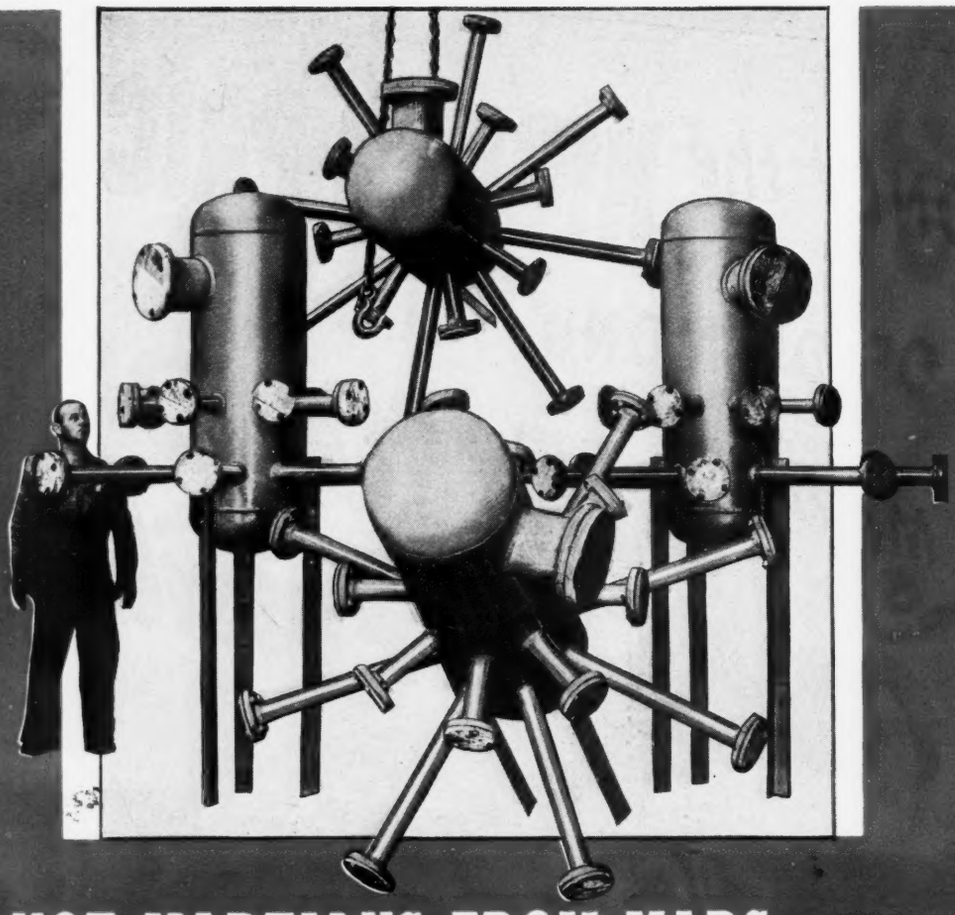
The overwhelming preference for Diamond Soot Blowers is doubly significant in view of their higher price. Diamond Soot Blowers cost more than other makes . . . but they are worth far more than they cost.

Power engineers everywhere recognize that Diamond Soot Blowers are far superior in engineering design, materials, workmanship and application. They have found it good business to pay a higher first cost for the exceptional economy, longer life and trouble free operation of Diamond Soot Blowers.

Features that contribute to Diamond Superiority include: (a) Flexible Element Connection that makes the element self-adjusting to movement of boiler tubes or boiler wall; (b) Clockwise or Counter-Clockwise Rotation; (c) Reduced Pressure Blowing; (d) 360° Blowing Arc; (e) External Longitudinal Adjustment of Element; (f) Dialoy Elements; (g) Calorized Elements; (h) Welded Bearings; (i) Elimination of Steam Waste; (j) Exclusive Service Policy that annually saves many thousands of dollars for users.

Write for Bulletin No. 884-A.

DIAMOND POWER SPECIALTY CORPORATION
Detroit, Michigan
DIAMOND SPECIALTY LIMITED, Windsor, Ont.



NOT MARTIANS FROM MARS—— BUT PIPE HEADERS FROM KELLOGG

These strange looking pipe headers were not inspired by H. G. Wells' "War of the Worlds." They were designed and prefabricated to perform a particular function for a Kellogg customer.

Prefabricated complete in the Kellogg Shops, these headers were shipped ready to connect on the job. They are made of 20" O.D. pipe, 3/8" thick, and are fitted with 17 accurately located nozzles—"Masterwelded" to the main shell.

The high quality of Kellogg shop-welding and the skill of Kellogg craftsmen are convincingly demonstrated in these headers.

If you have an unusual piping problem consult a Kellogg Engineer.

KELLOGG

THE M. W. KELLOGG COMPANY

JERSEY CITY • NEW JERSEY • 225 B'WAY, N. Y.

REPRESENTATIVES

LOS ANGELES: 1031 SOUTH BROADWAY HOUSTON, TEXAS
CHICAGO: 122 S. MICHIGAN AVE. TULSA: PHILTOWER BLDG.

"Masterflex" Prefabricated Piping Systems · **"Masterweld"** pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic Cracking Units. Thermal and Catalytic Polymerization Units · **JUIK Processes** for Lubricating Oil Plants. Plastic Refractories · Radial Brick Chimneys.

AKON... Complete Service ...Complete Protection!

AKON FEEDWATER Treatment includes the services of a salaried Service Engineer. It's his job to instruct your operators in making correct feedwater tests . . . make routine service calls . . . study reports and make recommendations (as shown above). He is at all times available for consultation. He's as close to you as your phone!

Read About the Savings You Get by Using Allis-Chalmers AKON Feedwater Service... the Modern Way to Fight the Ravages of Impure Steam! Specify AKON . . . and Save Money!

If you want modern power plant efficiencies . . . low fuel costs . . . long, trouble-free life from your operating equipment—you must safeguard it *at all times* from impurities in the water and steam you use!

That means AKON . . . the modern, up-to-the-minute feedwater method that gives continuous service and continuous protection!

Allis-Chalmers AKON Feedwater Service is a supplementary treatment to be used in conjunction with softeners and other chemicals to protect your equipment against corrosion . . . prevent scale . . . eliminate carry-over! There is no claim that AKON by itself solves any and all boiler ills. But — administered by experienced AKON Service Engineers — it is one of the most effective means ever discovered to keep your steam clean . . . reduce your plant operating costs . . . prevent plant shutdowns!

AKON is Low-Cost Insurance!

To protect your plant against the dangers of impure steam, AKON offers extremely low-cost insurance! Like many other leading power plant engineers, you too will find it pays to Specify AKON —in lower boiler cleaning costs . . . reduced chemical bills . . . prevention of plant shutdowns!

Find out about AKON...and how AKON Service will fit into the efficient operation of your plant. Write today for money-saving facts!

1055

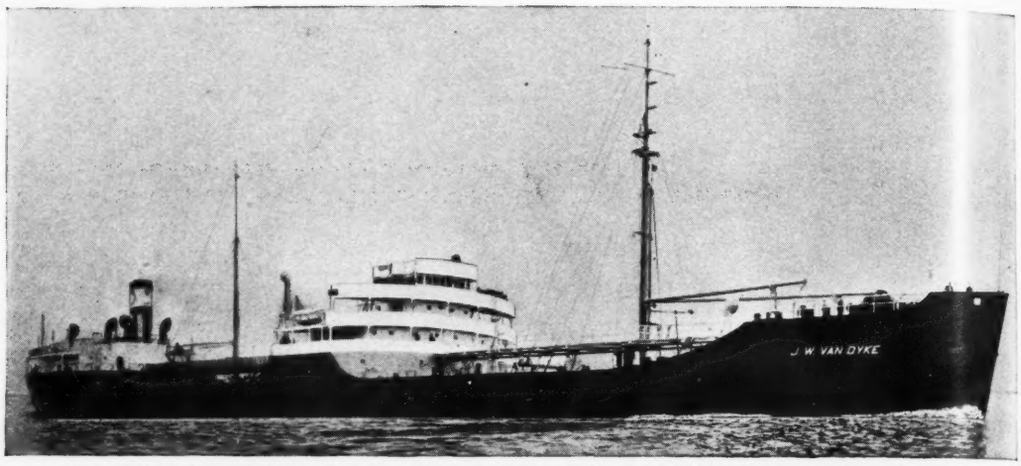
90 Years of Engineering Superiority Work for You When You Specify Allis-Chalmers!

FEED WATER TREATING DIVISION

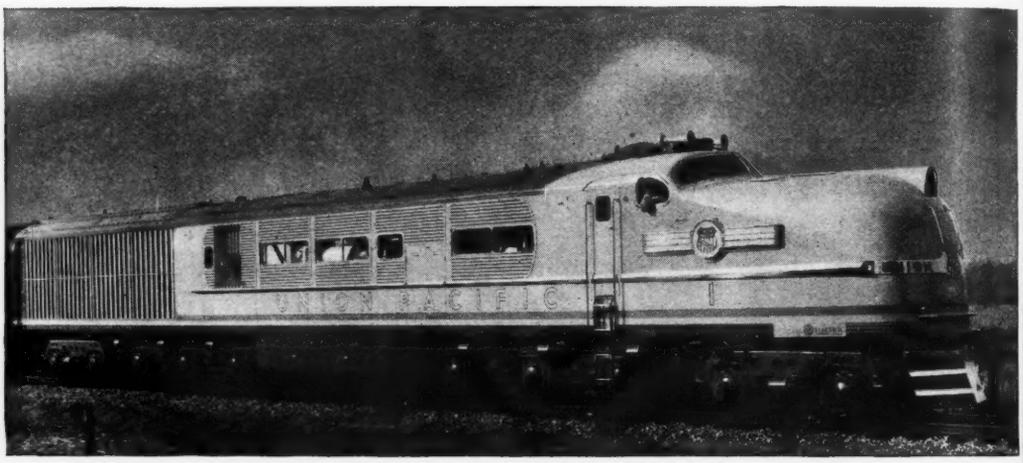
ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

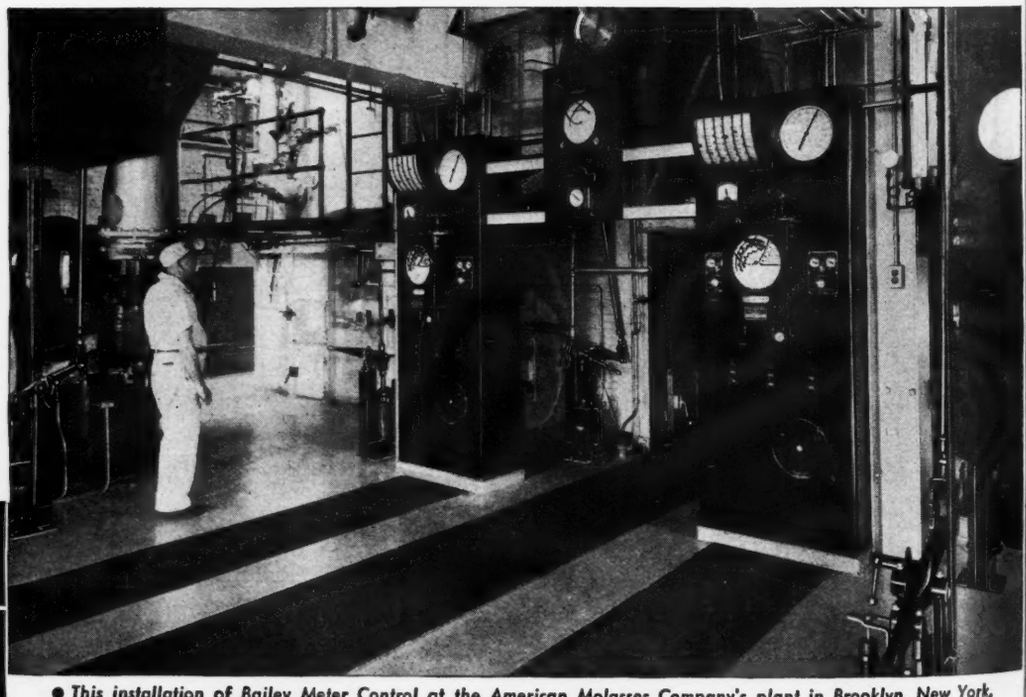
BOILER CONTROL



● *Aboard the Atlantic Refining Company tanker J. W. Van Dyke, Bailey Meter Control continuously maintains boiler efficiencies in excess of the manufacturer's guarantees.*



● *The 1500 pound pressure, 920 degree F. temperature steamotive boiler in this new Union Pacific steam-electric locomotive is operated automatically by Bailey Meter Control.*



● *This installation of Bailey Meter Control at the American Molasses Company's plant in Brooklyn, New York, during the first year created fuel savings equal to 122 per cent of its cost.*

BAILEY METERS

THAT "CAN TAKE IT"

At Sea

• Successful operation of Bailey Meter Control aboard tankers, cargo ships, dredges, and passenger vessels reflects the reserve of dependability which is built into this complete combustion control system.

On the Railroad

• "Railroading" is taken by the Bailey Meter Control System which automatically maintains steam pressure, combustion economy, and feed water flow aboard the new Union Pacific steam-electric locomotive.

In Your Plant

• The same extra reserve which fits Bailey Meter Control for marine and railroad service enables stationary steam plant operators to be sure of continuous economy, added safety, and increased continuity of service.

Complete information on this "high return" boiler room investment is contained in Bulletin No.102-B. May we send you a copy?

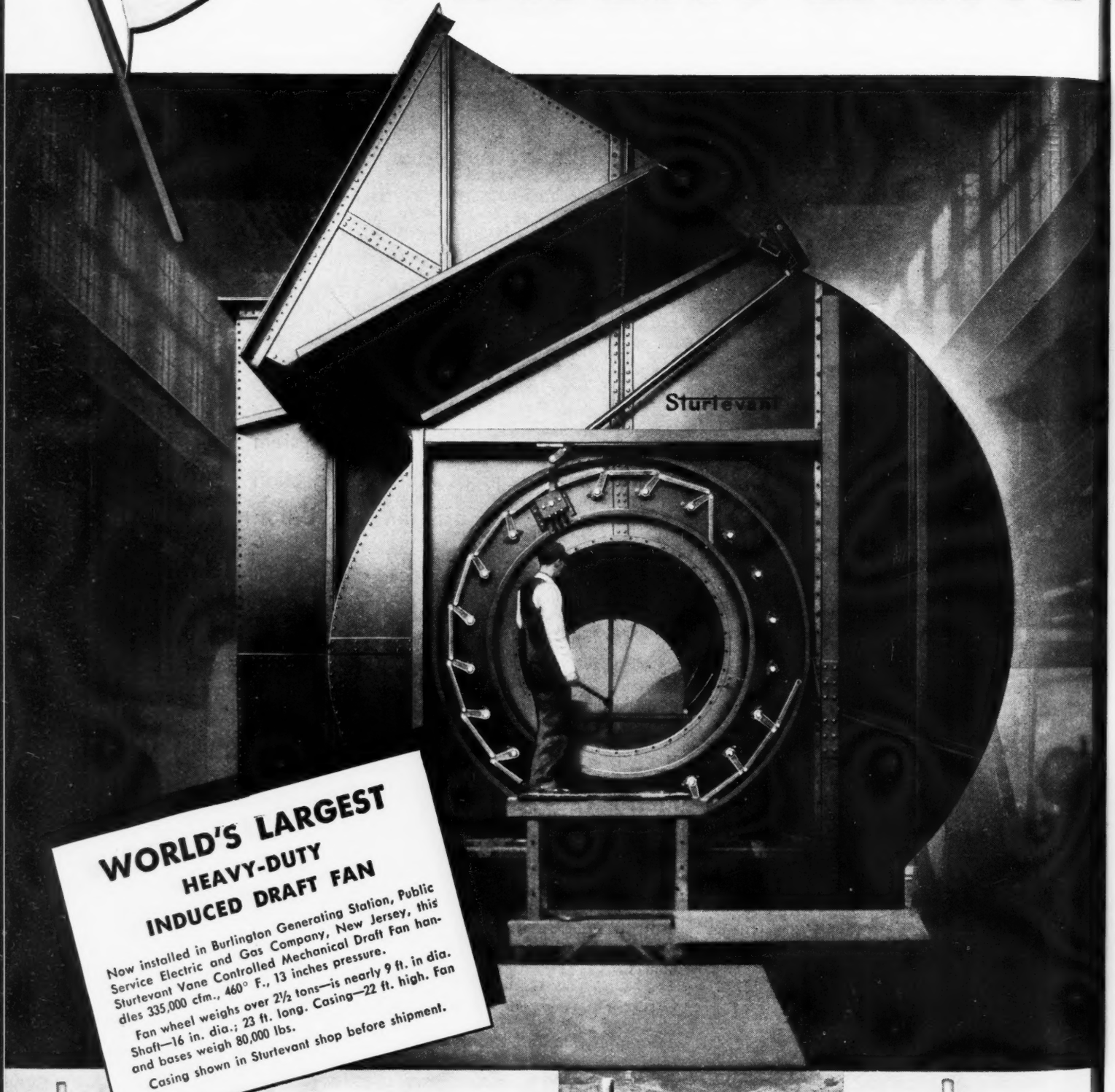
BAILEY METER COMPANY
1036 IVANHOE ROAD • CLEVELAND, OHIO
Bailey Meter Company Limited, Montreal, Canada A-49

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

BAILEY METER CONTROL

The Complete Combustion Control System

POWER PLANTS



WORLD'S LARGEST HEAVY-DUTY INDUCED DRAFT FAN

Now installed in Burlington Generating Station, Public Service Electric and Gas Company, New Jersey, this Sturtevant Vane Controlled Mechanical Draft Fan handles 335,000 cfm., 460° F., 13 inches pressure.

Fan wheel weighs over 2½ tons—is nearly 9 ft. in dia. Shaft—16 in. dia.; 23 ft. long. Casing—22 ft. high. Fan and bases weigh 80,000 lbs.

Casing shown in Sturtevant shop before shipment.

Burlington Generating Station, Public Service Electric and Gas Co., N.J., served by Sturtevant Forced, Induced Draft Vane Controlled Fans.

Richmond Station, Philadelphia Electric Company—18 Sturtevant fans for induced draft, forced draft, primary air, and pulverized coal mill service.

Gilbert Station, New Jersey Power & Light Company, Milford, N. J.—equipped with Sturtevant Forced and Induced Draft Vane Controlled Fans.

Deepwater (N. J.) Station, jointly owned by a subsidiary of Philadelphia Electric Co. and Atlantic City Electric Co., equipped with 12 Sturtevant Forced and Induced Draft Vane Controlled Fans.

along the DELAWARE

served by

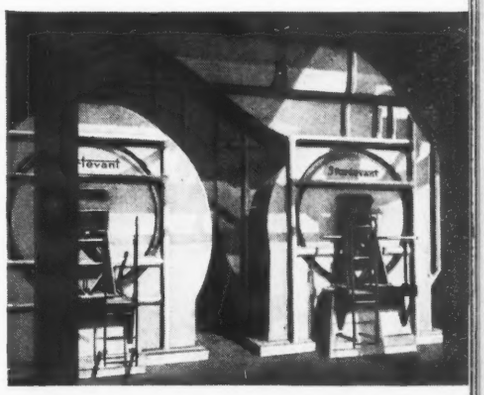
STURTEVANT MECHANICAL DRAFT FANS

STURTEVANT mechanical draft installations are meeting the exacting requirements of outstanding plants along the Delaware River.

The reason? High efficiency — ability to stand up under high speeds, high temperatures, high pressures, or large volumes — or the instant response to varying load demands which Sturtevant Patented* Vane Control can assure. No matter what your mechanical draft needs, Sturtevant can fully satisfy them.

Proof? You will find it in the service records of hundreds of Sturtevant installations — in a *large majority* of the country's public service power plants!

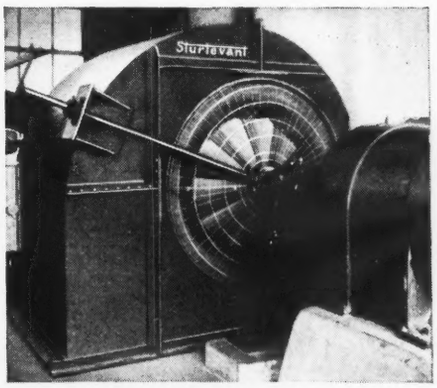
*United States Patent Nos. 1,460,428; 1,578,843; 1,846,863; 1,989,413



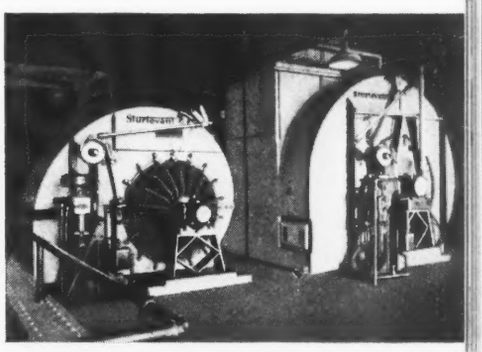
Sturtevant Induced Draft Fans serving 600,000 lb. per hour pulverized-coal-fired boilers for 225,000 hp. turbine in Richmond Station, Philadelphia Electric Company, Philadelphia, Pa.

B. F. STURTEVANT COMPANY
Hyde Park Boston, Mass.
Branches in 40 Principal Cities
B. F. Sturtevant Company of Canada Ltd.
Galt, Toronto, Montreal

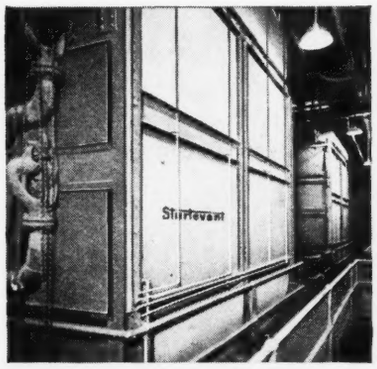
(Licensees of both the Allardice and Buell-Van Tongeren Systems of Dust Collection.)



At right:—This Sturtevant Forced Draft Vane Controlled Fan is one of four Sturtevant Forced and Induced Draft Fans serving the 120,000 lb. steam per hour boilers in plant of RCA Manufacturing Company, Inc., Camden, N. J.



Part of a battery of 12 Sturtevant Vane Controlled Mechanical Draft Fans serving six 1200 lb. boilers for the past 10 years—in Deepwater (N. J.) Station jointly owned by a subsidiary of Philadelphia Electric Co. and Atlantic City Electric Co.

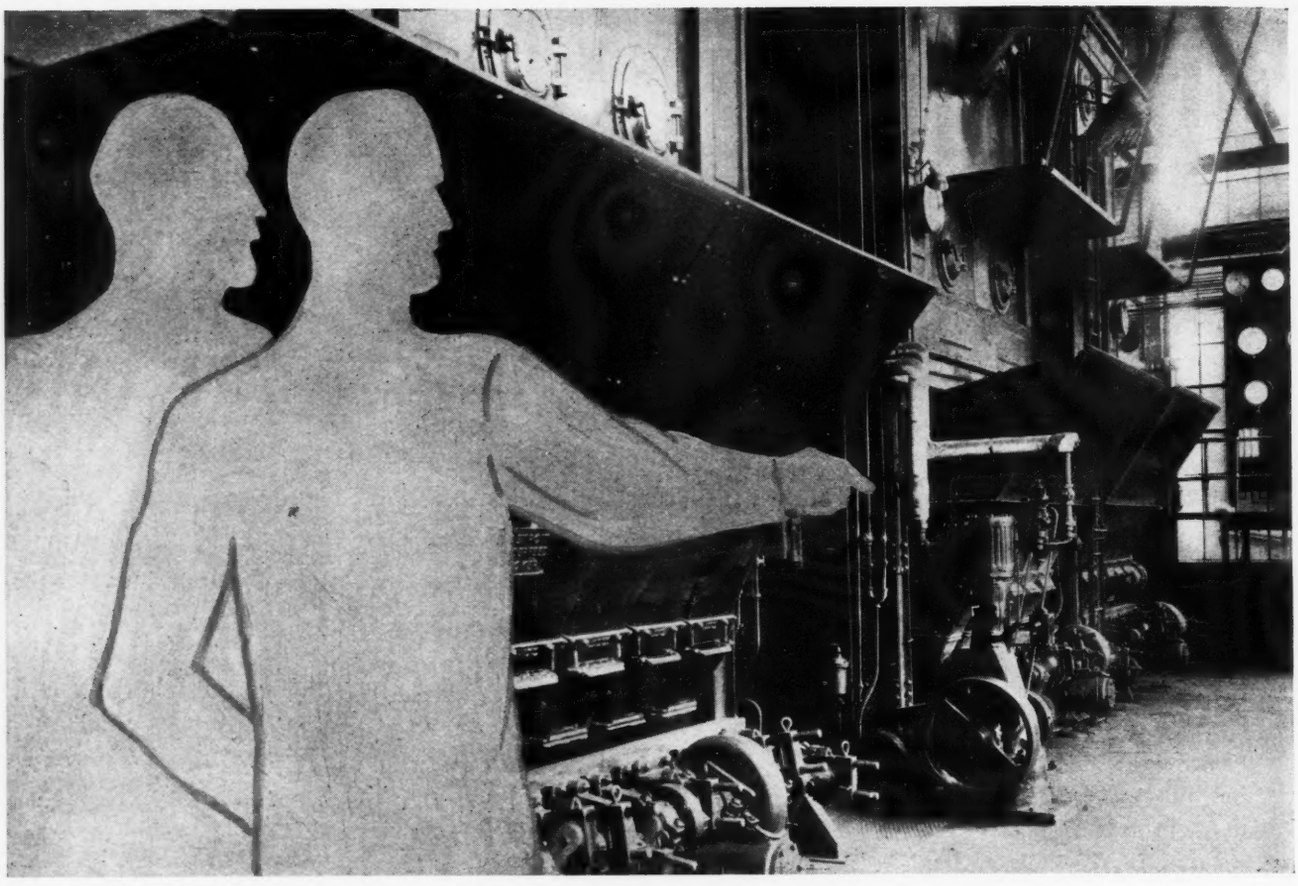


Part of five Sturtevant Extended Surface Steel Economizers at plant of Franklin Sugar Refining Co., Philadelphia, Pa. Each capable of handling at 200% boiler rating, 69,300 lbs. of water per hour, heating it from 210° to 282°F.

One of the Sturtevant Forced Draft Vane Controlled Fans serving 1350 lb. boilers, Gilbert Station, New Jersey Power & Light Co., Milford, N. J.

Sturtevant
REG. U. S. PAT. OFF.
Puts Air to Work

DRAFT FANS • TURBINES • GEARS • ECONOMIZERS • AIR HEATERS



"We haven't had a Repair Bill on that Troy Engine in Years"

½ cent per kilowatt hour
POWER COST
How 43 Leading Concerns and Institutions in 29 Different Industries cut Power Costs for Driving 19 Different Types of Auxiliaries to an Average of ½ cent per Kilowatt Hour

How Many Concerns Have Substantially Reduced Their Power Costs is detailed in Bulletin No. 101. Send for a copy.

Many a plant manager can say the same thing, for there are any number of Troy-Engberg Steam Engines, now operating, that have not had any repair bill—certainly no major repair—in fifteen to twenty years of steady service.

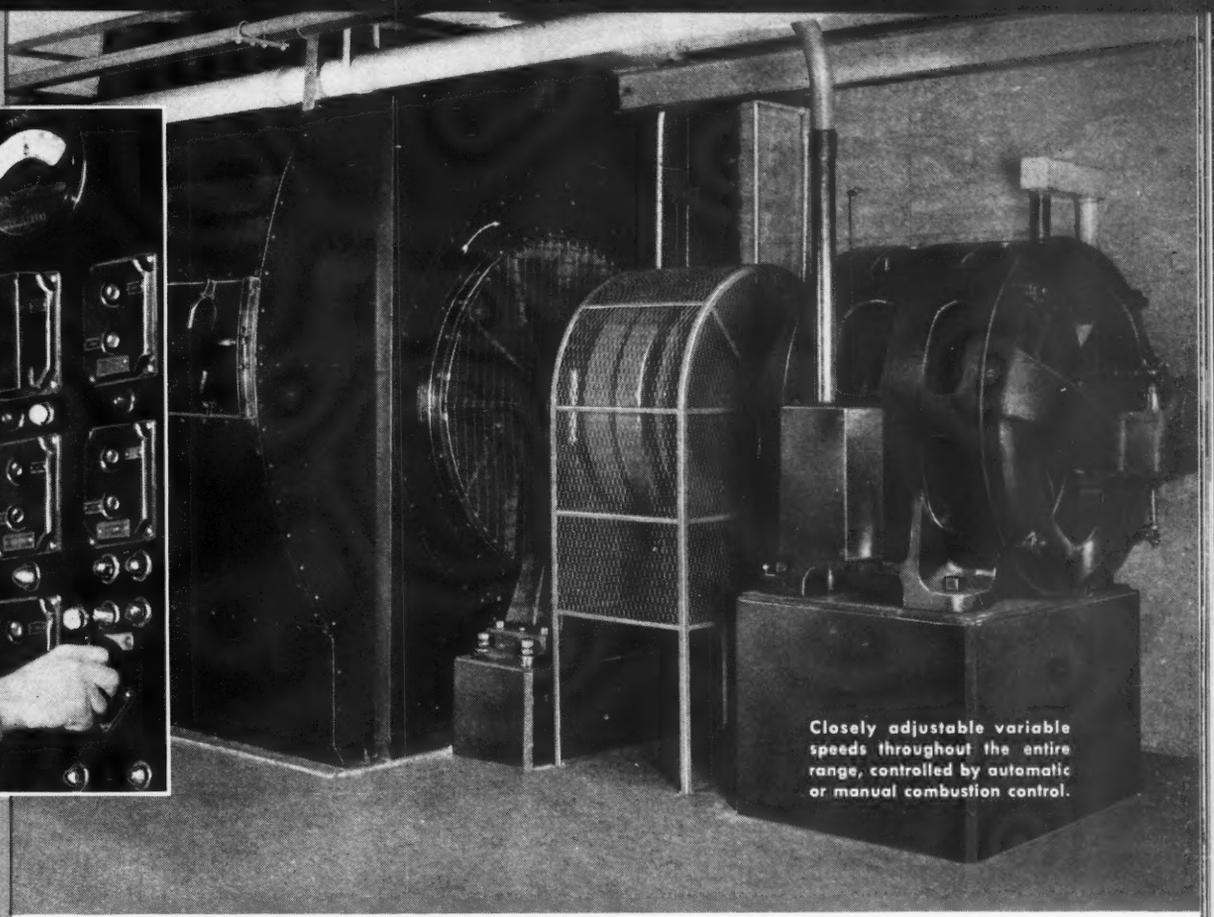
"How come?" you ask. Well, they are of simple design and well-made. They operate at conservative speeds. They have an efficient, automatic lubricating system. They can operate under a wide range of steam conditions.

On this score alone, the Troy-Engberg Steam Engine rates your consideration as the drive for your stoker, pump, compressor, fan, blower or any other kind of auxiliary unit. Low maintenance or none at all is but one of its cost-reducing features. Others point to very low cost for auxiliary power.

Send for literature that gives all the details.

TROY ENGINE AND MACHINE CO.
Established 1870
1456 Railroad Ave., Troy, Pa.

TROY-ENGBERG



Closely adjustable variable speeds throughout the entire range, controlled by automatic or manual combustion control.

NEVER BEFORE!

Such simple, dependable, efficient, accurate, low-cost boiler fan control

Simple

- ✓ Only 2 parts, no mechanical torque connection, no friction or wear. Speed control by simply varying a small control current.

Effective

- ✓ Closely adjustable speed control from full speed to 10% speed.

Efficient

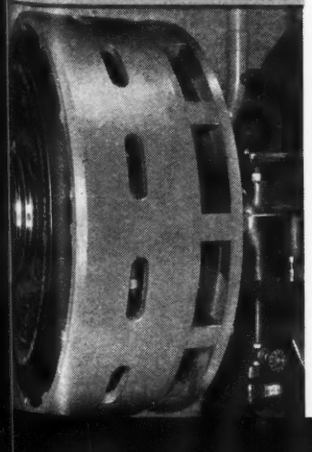
- ✓ Power loss lower than in other widely used methods of boiler fan control. Makes practical the use of synchronous motors with their high efficiency, high power factor.

Adaptable

- ✓ Quickly, easily installed on new or existing fan drives, requiring little more overall length than that taken by the usual coupling it can replace.

Inexpensive

- ✓ First cost is attractive . . . pays for itself in power savings, better boiler control and reduced maintenance.



The new outstanding E-M Magnetic Drive . . . simple, successful, economical, efficient and compact. Easy to install on existing fans.

The E-M Magnetic Drive is the new outstanding method of obtaining variable boiler fan output by varying fan speed. It provides closely adjustable variable speed throughout the entire range—from 10% to full speed. And withal, the E-M Magnetic Drive is so simple, so precise, so efficient, so easy to install, that it is superior to other methods of fan output control now in use. *Progressive power plant engineers will find in the many features of this new Drive a needed answer to the problem of variable boiler draft fan control.*

Essentially, the E-M Magnetic Drive consists of two simple parts . . . a flux linkage ring for the motor drive shaft . . . and a magnetic flux producer for the fan shaft. Speed is varied simply by varying the small control current of the Magnetic Drive, in conjunction with either automatic or manual combustion control. Torque variation to vary speed is entirely magnetic . . . there is no mechanical torque contact, no wear or tear. The motor may be started without load, and synchronous motors with their high efficiency and controllable high power factor can now be used perfectly in this variable speed application. Maintenance costs are cut to the minimum, and the Magnetic Drive pays for itself by its low losses and the better boiler control it provides.

The flexibility and wide range of control, the simplicity of installation, the efficiency of the E-M Magnetic Drive answer problems faced by power plant engineers everywhere. The attractive first cost of the E-M Magnetic Drive makes it a solution no engineer can afford to overlook. Write at once for publication 161, a 4-page folder describing the E-M Magnetic Drive and its application to fans. ELECTRIC MACHINERY MFG. COMPANY, 1345 Tyler Street, N.E., Minneapolis, Minn.

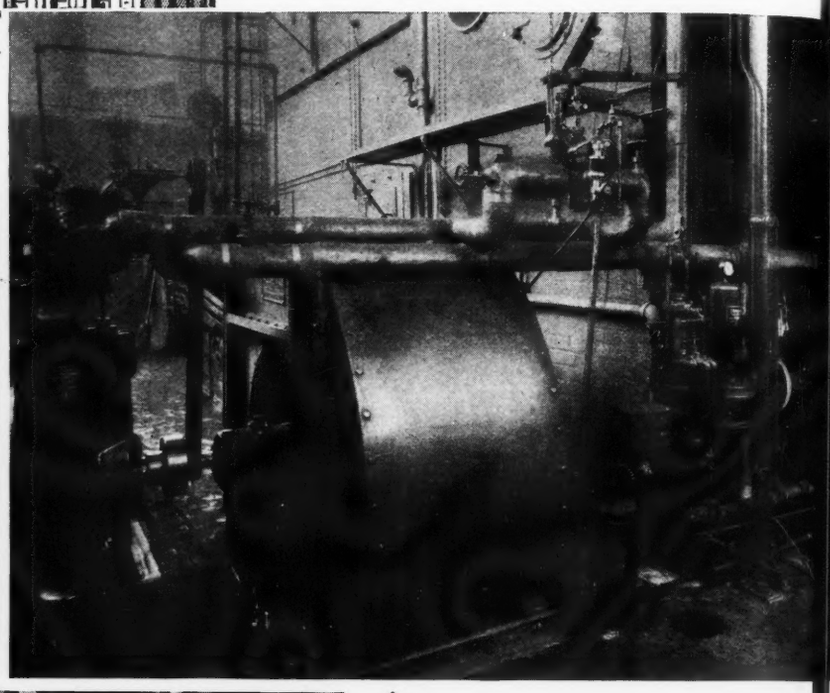
EM

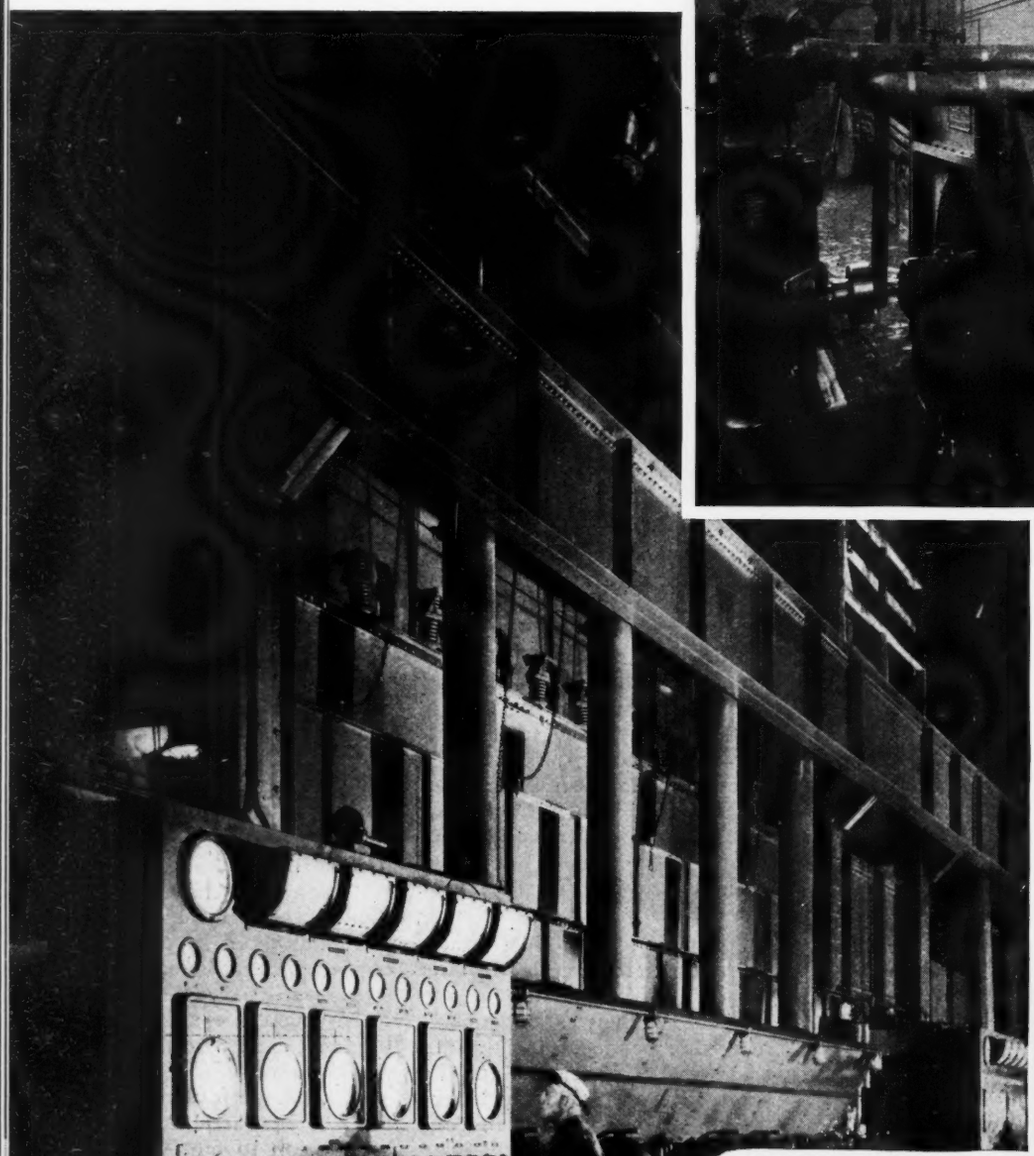
MAGNETIC DRIVE

Variable Speed at the Twist of a Wrist

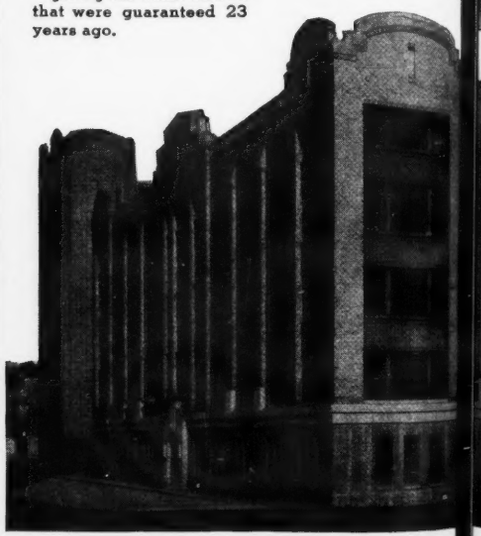
Born 23

An Idea





CRUDE AS IT IS by present day standards, this early installation of Hagan Automatic Combustion Control is still functioning today—giving the same results that were guaranteed 23 years ago.



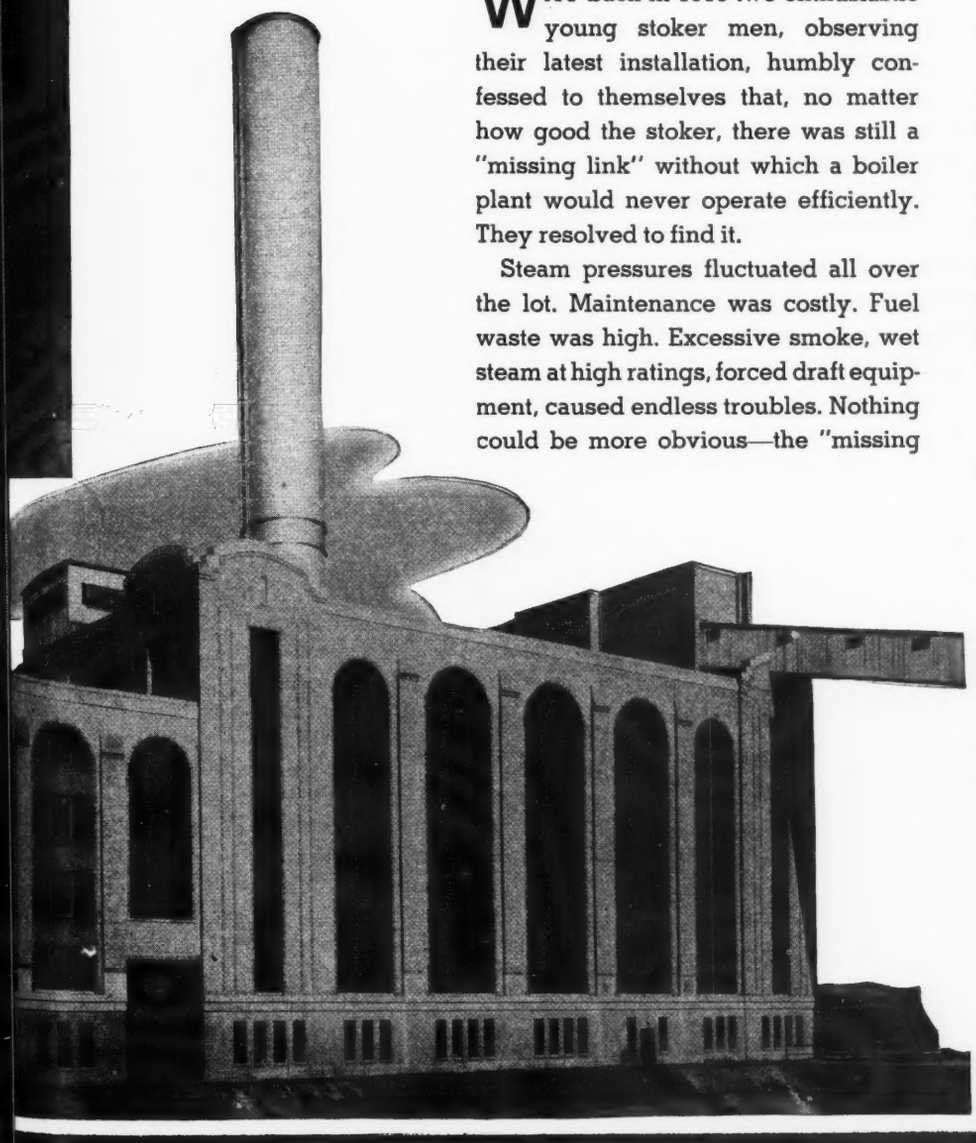
COMBUSTION

MODERN INSTALLATION of Hagan Automatic Combustion Control in one of the largest and most efficient stations of a metropolitan power company. This equipment controls combustion for the generation of 700,000 to 800,000 pounds of steam per hour. No job is too big or too difficult for Hagan engineers.

Years Ago!

that changed an Industry

Millions saved in power costs!



WAY back in 1916 two enthusiastic young stoker men, observing their latest installation, humbly confessed to themselves that, no matter how good the stoker, there was still a "missing link" without which a boiler plant would never operate efficiently. They resolved to find it.

Steam pressures fluctuated all over the lot. Maintenance was costly. Fuel waste was high. Excessive smoke, wet steam at high ratings, forced draft equipment, caused endless troubles. Nothing could be more obvious—the "missing link" was lack of adequate control. The problem was how to get it.

It was several trying years before the idea could be turned into reality. Finally they succeeded in developing and producing the first practical system of automatic combustion control. It worked! They knew they had licked the biggest problem in steam production. From it came The Hagan Corporation, the revolutionizing of power plant operation, the saving of millions of dollars.

That was 23 years ago. The original young stoker men are veterans now in a practice that has become universally accepted. From the start, they surrounded themselves with men with whom engineering was a passion. They never lost their instinct for pioneering. There always has been a Hagan Control System ready to meet advancing needs. There always will be. Whatever your problem, we shall be pleased to hear from you.

HAGAN

and CHEMICAL ENGINEERS

Giant 23 . . . and still the Leader

THE HAGAN CORPORATION

300 ROSS STREET · PITTSBURGH, PA.

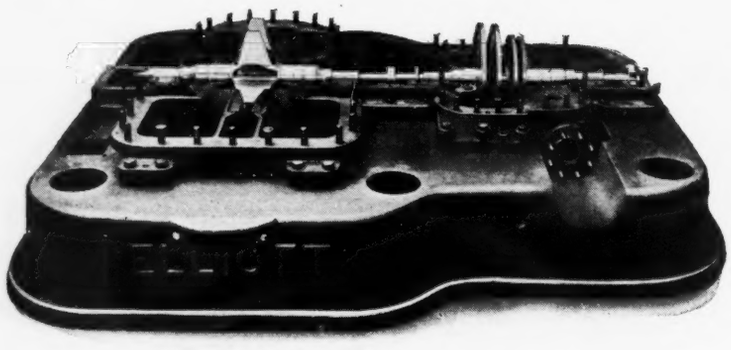
"It takes more than HOT CORROSIVE GASES to End MY Run!"

Single-stage double-inlet centrifugal blower direct-driven by 3-stage steam turbine, as manufactured by Elliott Company, Jeannette, Pa. Blower shaft and inserted blades are machined from "K" Monel forgings, heat treated to 305 Brinell.

"K" MONEL*... a heat-treatable Nickel-copper alloy for applications requiring extreme strength and hardness. Easily forged and machined prior to heat treatment. Available as bars, rods, forgings and as strip. Tensile strength 110-165,000 p.s.i. Hardness 150-325 Brinell.

"S" MONEL*... a cast Nickel-copper alloy rendered extra hard and heat-treatable through the addition of silicon. Offers valuable non-galling characteristic, and will not seize when used with Monel. Tensile strength 90-115,000 p.s.i. Hardness 280-350 Brinell.

MONEL*... two-thirds Nickel and one-third copper, combines resistance to corrosion with strength and toughness. Available in all mill forms. Tensile strength 70-115,000 p.s.i. Hardness 120-200 Brinell.



"K" Monel replaces high iron alloy for shaft and blades of centrifugal blower

Did you ever run into a tougher power plant application than this centrifugal blower job? Plenty of reason why "K" Monel was selected to replace the original metal. Consider the conditions:

This single-stage double inlet centrifugal blower is direct-driven by a 3-stage steam turbine. It operates at 12,500 r.p.m. The saturated gas which it handles at 160°F. contains large quantities of dirt and sulphur compounds. A pretty tough assignment, you'll agree. Yet what makes this punishment even more gruelling is *continuous operation 24 hours a day.*

What were the blower shaft and blades made of originally? And what happened to them? Made of high iron alloy, they corroded badly in short order.

Now, *that* kind of grief is ended. So also is undue erosion and wear. For the new "K" Monel shaft has inserted blades machined from "K" Monel forgings heat treated to 305 Brinell... and so is built to withstand heat, corrosion, erosion and wear.

Other Nickel alloys used in this unit are ... for bed plate and blower casing, ½% Nickel cast iron; turbine rotor shaft, 3½% Nickel steel; coupling bolts, 3½% Nickel steel; and garter springs on carbon block packing of turbine glands, Monel.

On tough power plant applications it pays to use "K" Monel and other Nickel alloys. Write for technical data on the high Nickel alloys. Ask also for the booklet "Strength Plus." Address:

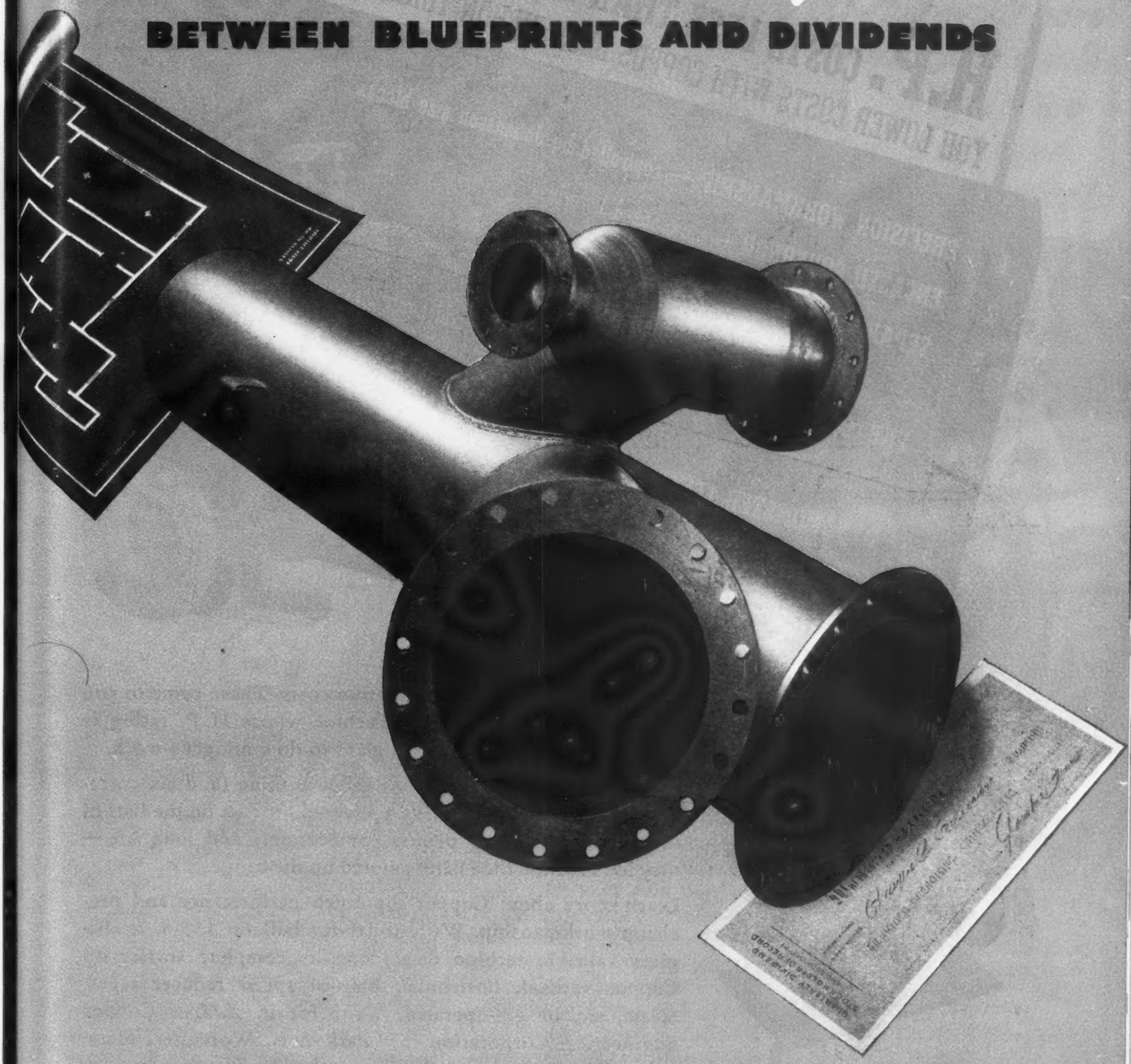
THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street **New York, N. Y.**

MONEL

"Monel" and other trade-marks which have an asterisk associated with them are trade-marks of The International Nickel Company, Inc.

Shortest Bridge

BETWEEN BLUEPRINTS AND DIVIDENDS



YOUR money begins to flow *out* when you start your new plant or modernization. But it won't flow *in* again until the job is finished and running.

Grinnell Prefabrication can cut days and weeks off the time between investment and return. Accurate sub-assemblies like that shown are easily field-welded into a finished piping system.

Grinnell plants are strategically located to serve the continent quickly. For piping that's an exact interpretation of your plans, pre-tested to qualify for insurance, and constructed to standards commercially practical and technically sound, "Give the plans to Grinnell." Grinnell Company, Inc., Executive Offices, Providence, R. I. Branch offices in principal cities of the U. S. and Canada.

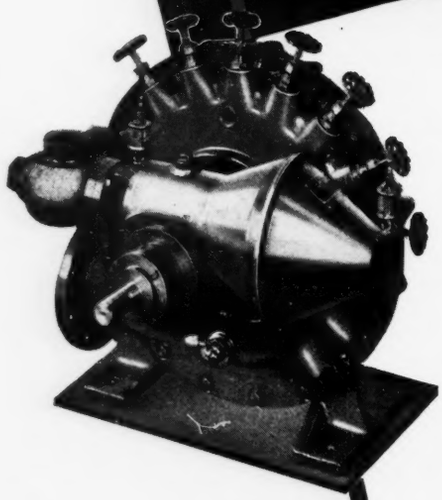
PREFABRICATION BY **GRINNELL**

WHENEVER **PIPING** IS INVOLVED

H.P. COSTS LESS THAN E.P.*

YOU LOWER COSTS WITH COPPUS BLUE RIBBON TURBINES (Fractional to 150 H.P.)

1. PRECISION WORKMANSHIP — controlled by Johansson size blocks
2. ENCASED GOVERNOR — slow speed leverless
3. SEPARATE SAFETY TRIP — pilot-operated leverless
4. PARTIAL LOAD ECONOMY — by individual nozzle control
5. DYNAMOMETER TESTED — before shipment
6. 85% REPEAT ORDERS — 85.6% in 1937 86.4% in 1938



COPPUS STEAM TURBINE SHOWING TEN NOZZLES of which SEVEN ARE CONTROLLED INDIVIDUALLY by HAND VALVES.

All Coppus Steam Turbines have as standard equipment a large number of nozzles with individually controlled hand valves so that it is possible to operate at close to full load efficiency when the H. P. requirements are reduced. By closing individual hand valves, full steam pressure can be carried in the steam chest, even if the actual load is temporarily as low as 30% of the full rating.

Less investment. Lower installation costs. These come to you when you pick the Coppus Turbine whose H. P. rating is *closest* to your job. Why buy a giant to do a midget's work?

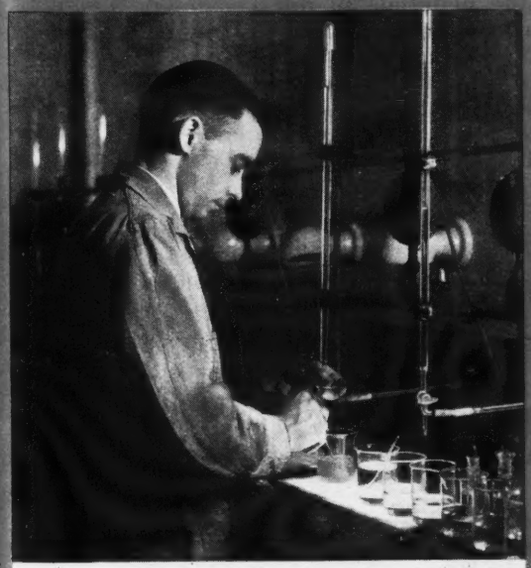
Six sizes of the Coppus Blue Ribbon turbine (and six corresponding prices) make this a preferred product on the lists of the country's leading plants. For economy and long life — they look for the Blue band painted on the flange.

Learn more about Coppus top-notch performance and precision workmanship. Write today for bulletin 135-8. It also gives valuable turbine data, contains complete stories on Coppus vertical, horizontal, built-in speed reducer types. Steam, air, or gas-operated. Write for it. *Address* Coppus Engineering Corporation, 350 Park Ave., Worcester, Mass. *Sales offices in* Thomas' Register; *other products in* Sweet's.

COPPUS

*E.P. Expensive elephant power for a job an inexpensive Coppus would do.

Prevent scale troubles - the DEARBORN WAY



Water Samples Are Carefully Analyzed in the Dearborn Laboratories

With the data obtained from these laboratory tests and with complete information regarding the water supply and operating conditions, it is possible for Dearborn to recommend an effective chemical treatment and control procedure.

Wasted fuel, frequent turbining, expensive tube replacements—all result from bad scale conditions. Thousands of steam plants all over the country have eliminated these troubles and are making substantial savings by using Dearborn Water Treatment and Engineering Service. Not only does Dearborn Treatment prevent the formation of new scale, but it gradually disintegrates scale already present, without boiler shutdowns.

But the Dearborn Water Treatment System does not stop with eliminating scale troubles. It also provides full protection against pitting and corrosion. Dearborn also takes the necessary steps to determine and correct the causes of steam contamination.

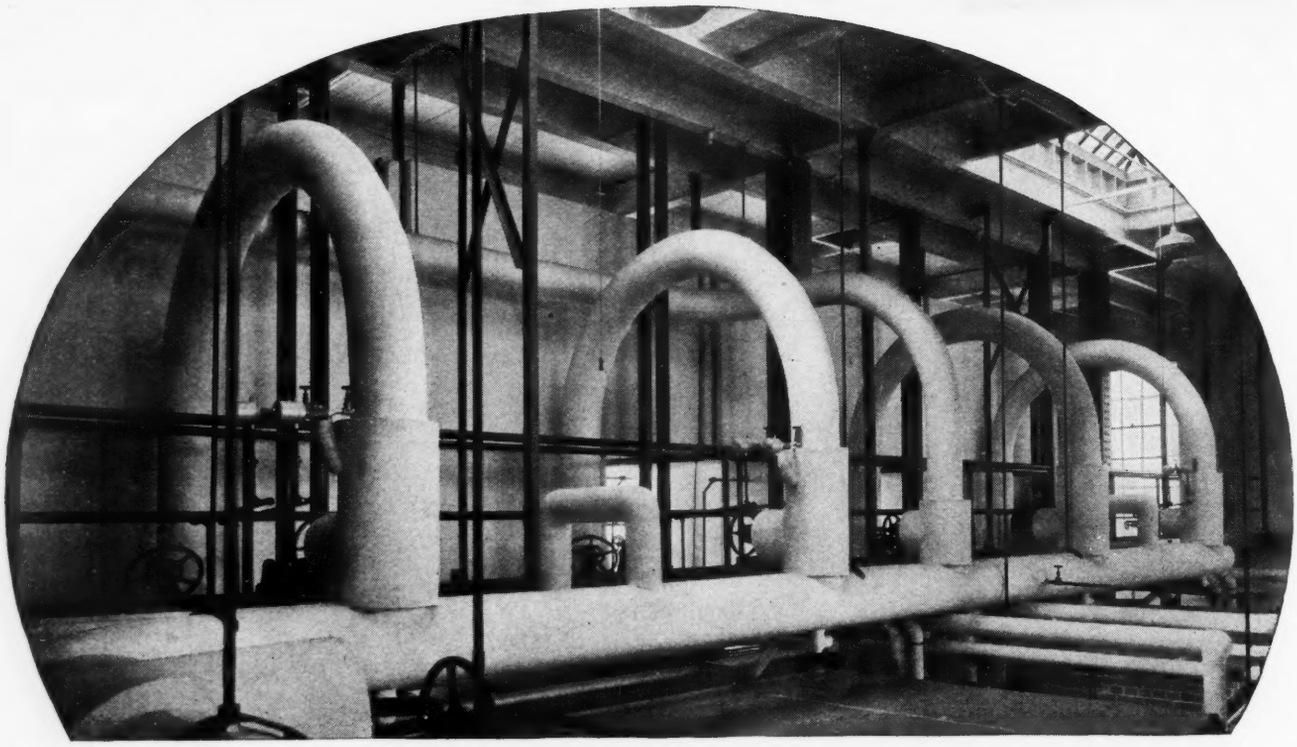
The cost of Dearborn Treatment is small compared with the savings it makes and the freedom from worry it brings both plant owner and engineer. Dearborn engineers will be pleased to make an analysis of your plant and show you what savings Dearborn Treatment will make.

Dearborn Chemical Company
Dept. D
310 S. Michigan Ave., Chicago

Dearborn
TRADE MARK REGISTERED

WATER TREATMENT
AND ENGINEERING SERVICE

CHICAGO • NEW YORK • LOS ANGELES • TORONTO and PRINCIPAL CITIES



K & M INSULATION CONSERVES HEAT AND FUEL IN MANY U. S. GOVERNMENT BUILDINGS

Above is illustrated the boiler room in a U. S. Government institution at Fort Worth, Texas—one of the many government buildings in which K & M insulations save heat and fuel. Steam lines are insulated with Keasbey & Mattison "Featherweight" 85% Magnesia, one of the most efficient heat insulators ever developed for temperatures up to 600° F.

The materials were supplied and installed by the Mundet Cork Corporation of Houston, Texas, who say: "We not only supply insulation products, but provide a specialized insulation service which includes the correct application of the materials in our customers' plants. This means that our products must be right if our service is to create lasting satisfaction and build further business. K & M insulation products invariably do their part in making each job a sound investment for our customers. And that makes them the soundest investment for us."

K&M

Keasbey & Mattison engineers, working with K & M Distributors strategically located throughout the country, can point the way to real savings in your plant, too. Why not write Dept. 11 for further details?

"FEATHERWEIGHT" 85% MAGNESIA

"The Time-Proven Insulation"

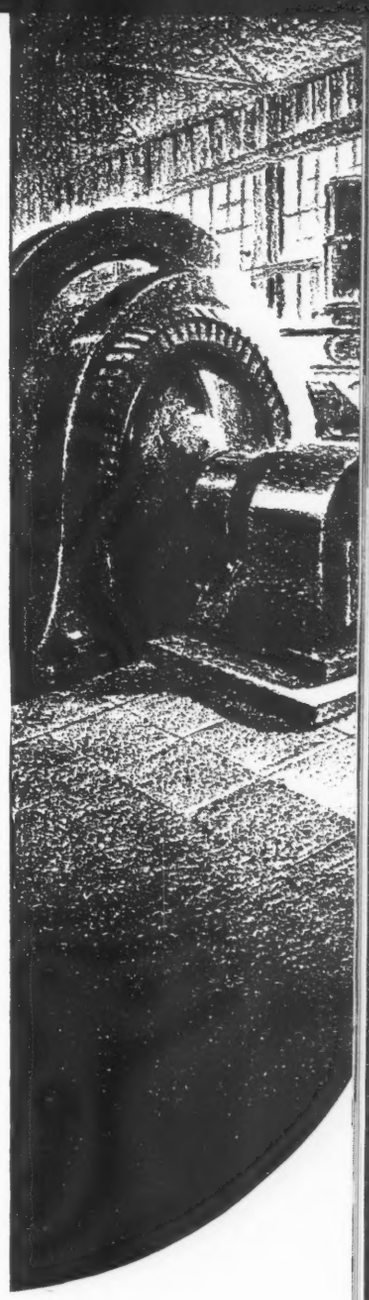
KEASBEY & MATTISON

COMPANY, AMBLER, PENNSYLVANIA

K&M insulation materials are the products of specialists. The Keasbey & Mattison Company has pioneered for more than half a century in the development of Asbestos and Magnesia products. Its leadership as a producer of quality materials is equalled by its nation-wide system of prompt service through strategically-located warehouses of K & M Distributors.

POWERED *for* PROFITS

with effective accident *prevention*



POWER PLANT *protection* POINTERS.. NO 6

You make money only as long as your power plant **works.** A breakdown means more than cost of repair: it means loss of revenue and prestige. "Ocean and Columbia" service not only covers you in the first case . . . but prevents accidents **from happening.** "Ocean and Columbia" maintain a highly competent inspection staff composed of licensed engineers who bring with them a rich experience gained in many types of power plants — and special training in the works of leading manufacturers of power plant equipment.

Back of this vigilant inspection — and backed in turn by the almost unlimited financial strength of their own and affiliated organizations — is a notable record of prompt payment for losses. Inspection — service — and adjustment are all in the hands of experts and engineers . . . who talk your language and understand your operating conditions.

INDUSTRIAL *and* UTILITY POWER PLANT *insurance*

THE OCEAN ACCIDENT AND GUARANTEE CORPORATION, LIMITED

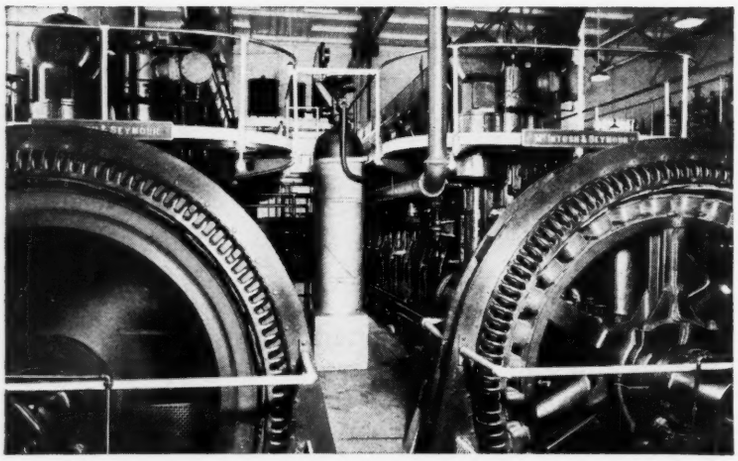
COLUMBIA · CASUALTY COMPANY

THE OCEAN ACCIDENT & GUARANTEE CORPORATION
COLUMBIA CASUALTY COMPANY

One Park Avenue, New York, N. Y.

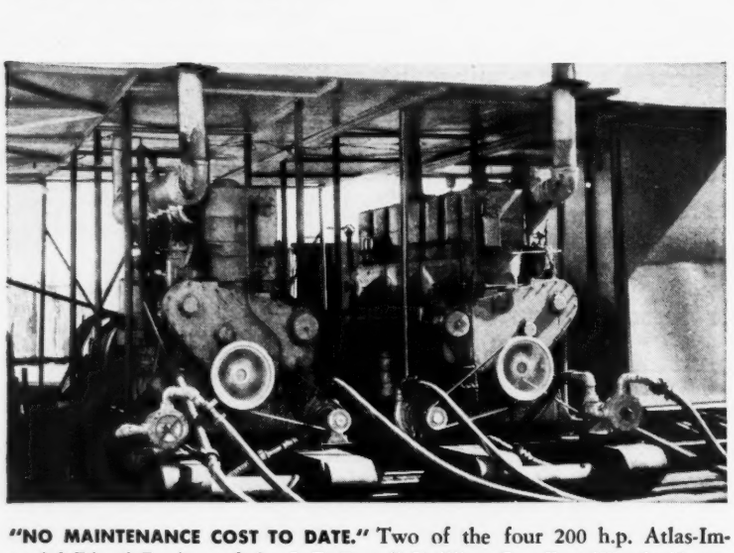
Pacific Department: 315 Montgomery Street, San Francisco, California
Canadian Branch: The Ocean Accident & Guarantee Corp., Ltd., Federal Building, Toronto, Ontario
Cuban Correspondent: Compania Cubana de Fianzas, Amargura 23, Havana, Cuba

3 WIDESPREAD EXAMPLES OF WORK WITH LITTLE WEAR



"SMALL AMOUNT OF CYLINDER WEAR," is the way the engineer's report reads. It refers to the two 900 h.p. McIntosh & Seymour Diesel Engines in the electric light plant at Tarboro, No. Carolina.

Size of cylinders 17" dia. After 49,000 hours of operation, greatest wear is .010", smallest .002". Engines lubricated with Texaco Ursa Oil 100%, "No trouble with carbon . . . rings free."



"NO MAINTENANCE COST TO DATE." Two of the four 200 h.p. Atlas-Imperial Diesel Engines of the J. E. Farrell Drilling Co., Fort Worth, Texas.

This equipment has drilled fourteen oil wells.

Engines are operated continuously for 30-day periods in this grueling service.

Texaco Ursa Oils have been in use since starting up.

Texaco Dealers invite you to tune in The Texaco Star Theatre—a full hour of all-star entertainment—Every Wednesday Night—Columbia Network—9:00 E.S.T., 8:00 C.S.T., 7:00 M.S.T., 6:00 P.S.T.

THROUGHOUT ALL INDUSTRY, Diesels are providing tremendous power in continuous day-and-night service, year after year.

Moreover, they are giving this service in many cases *without measurable wear* on pistons, cylinder liners, bearings . . . especially when continuously lubricated with Texaco Algol or Ursa Oils.

More stationary Diesel horse-power in the United States is lubricated with Texaco than with any other brand.

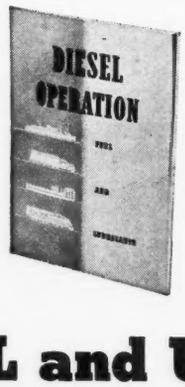
Experienced lubrication engineers, trained in the selection and application of Texaco Diesel Lubricants, will be glad to demonstrate that savings can be made with Texaco Perfected Lubrication.

For prompt engineering service and deliveries, phone the nearest of our 2279 warehouses in the U. S., or write: The Texas Company, 135 East 42nd Street, New York, N. Y.

"VERY LITTLE WEAR" after a year's service, reads the report on this tractor, built by the Lombard Traction Engine Co., Waterville, Maine.

In 35 days, this equipment hauled 5,729 cords of pulpwood, each weighing 3,600 lbs., or a pile 4 feet high measuring 868 feet long.

Its 6-cylinder Fairbanks-Morse Diesel Engine is lubricated with Texaco Algol Oil. No stuck rings, very little wear, is the report. Photos show tractor with wheels and with sleds.



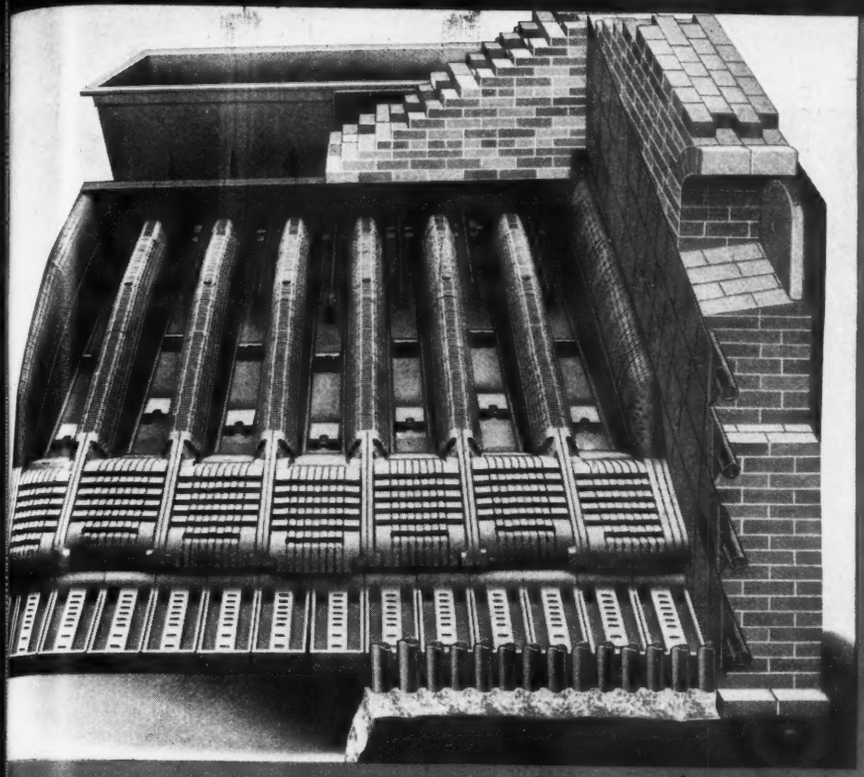
DIESEL OPERATION— 80 pages of charts, diagrams, photographs and text that answer many questions that come up each day. Write for your copy.

TEXACO

TEXACO ALGOL and URSA OILS

DETROIT MULTIPLE RETORT STOKER

Fuel movement is always under complete mechanical control.

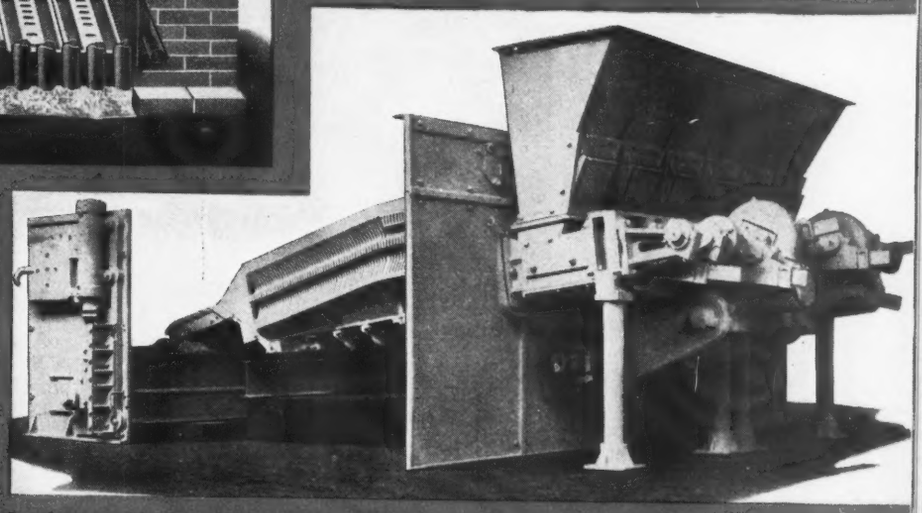


Rear View, showing large capacity retorts with adjustable moving extension grates.

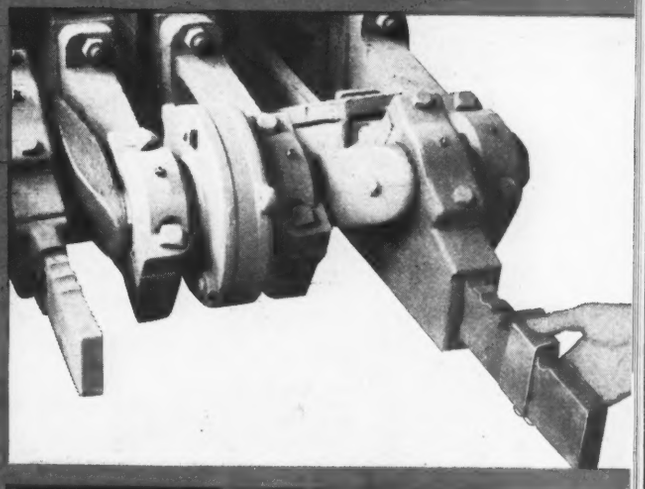
OUTSTANDING FEATURES

- Inclined Retorts with decreasing depth, permits slow distillation of gases and effective underfeed action.
- High air-cooled, side-wall tuyeres prevent clinker formation and erosion of side-walls.
- Moving retort bottoms insure uniform fuel distribution under all load conditions.
- Large square rams operate in ram cases with adjustable liner plates.
- Easy adjustments of the stroke of rams and moving retort bottoms control the fuel feed and distribution.
- Extension moving grate sections have slicing action to effectively burn out coke.
- Operating mechanism for dumping grates, either power or manually operated, is accessibly mounted at the side.
- Mechanical drives, with machine cut worms and gears, mounted in roller bearings, running in oil, require little power.

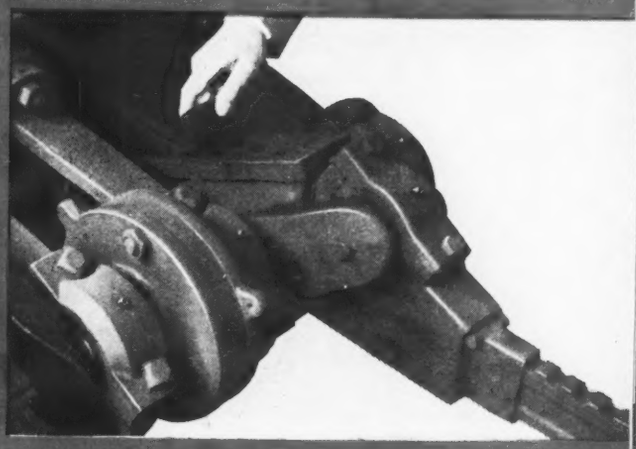
Write For Bulletin No. 130



Ready for shipment. Note power operated ash dumping mechanism accessibly located at the side.



Coal feed adjustment for each retort, made while Stoker is operating.



Convenient adjustments for controlling fuel distribution by changing stroke of each individual moving retort bottoms.

DETROIT STOKER COMPANY

SALES AND ENGINEERING OFFICES: GENERAL MOTORS BUILDING, DETROIT, MICHIGAN
MAIN OFFICE AND WORKS: MONROE, MICHIGAN • *District Offices in Principal Cities*

130 B.C. THE AEOLIPYLE

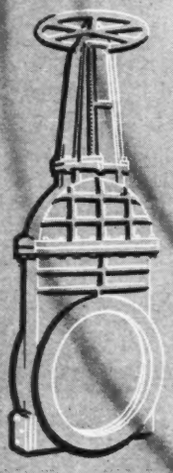
A globe with one or more tubes from which steam is passed, the steam jets causing the vessel to revolve. Described by Hero of Alexandria in 130 B.C. and often called the first steam engine.

You may get a print from the original wood cut from which this is reproduced—richly mounted and suitable for framing. Write Reading-Pratt & Cady.

The dramatic story of the Aeolipyle said nothing of the pressure or temperature of steam. 1900 years later, 7 lbs. of steam was enough for Watt. But, with 60 lbs. considered adequate in 1870, we find projects employing 200 lbs. of steam scarcely ten years later.

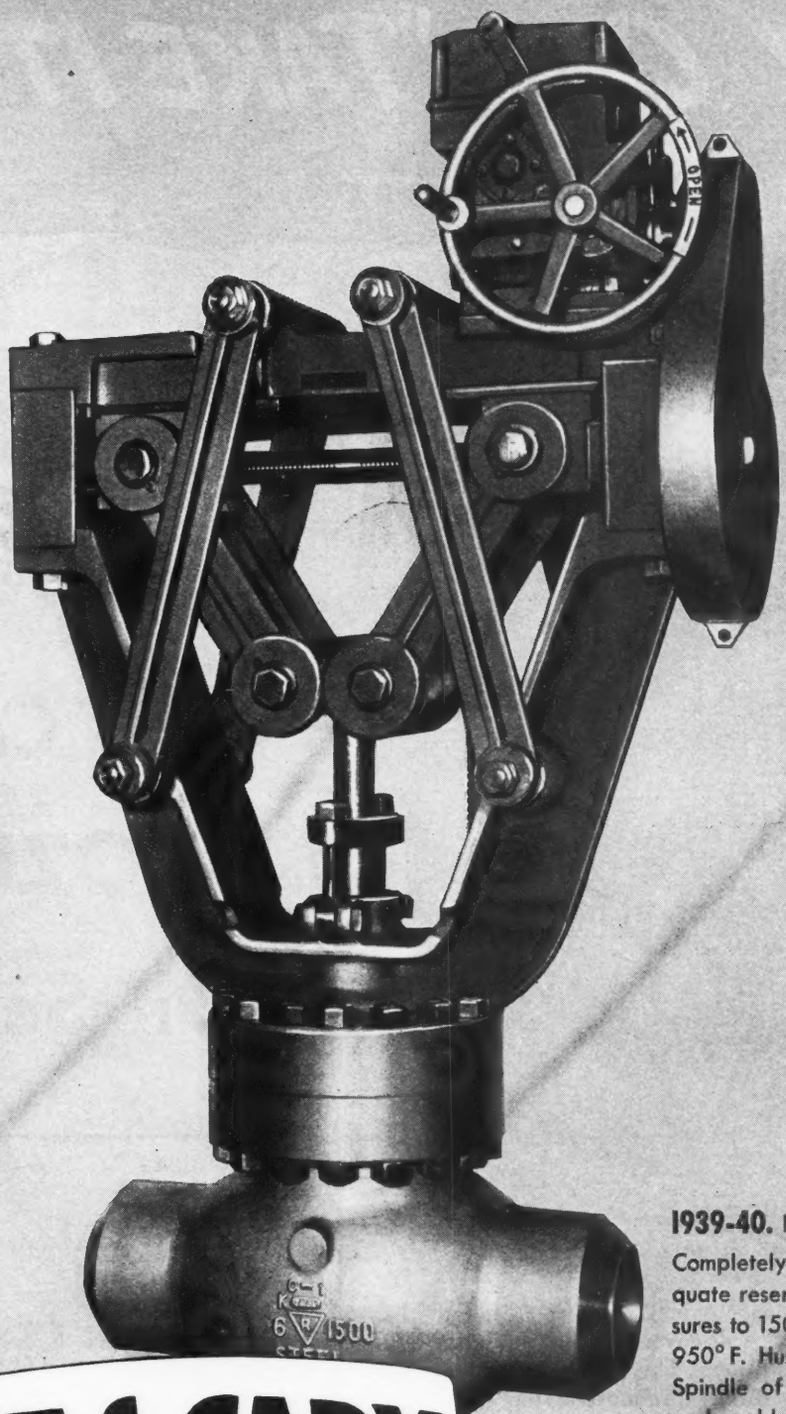
During this latter period of important change, Pratt & Cady opened their shops at Hartford. And when many desired temperatures and pressures rose beyond the ability of iron and bronze to endure, Reading was found pioneering in the production of pressure castings of steel alloys for valves.

Today, the union of these two pioneers in the application of bronze and iron and steel valves to the problem of the steam power plant should certainly offer a dependable source of recommendations for your valves.



READING

READING-PRATT & CADY



1939-40. FIG. 15031

Completely engineered to meet, with adequate reserve, the stresses of steam pressures to 1500 lbs. and of temperatures to 950° F. Husky body of molybdenum steel. Spindle of Stainless Steel. Stellited disc and welded-in seat ring. The modern Cast Steel Valve. By Reading-Pratt & Cady.

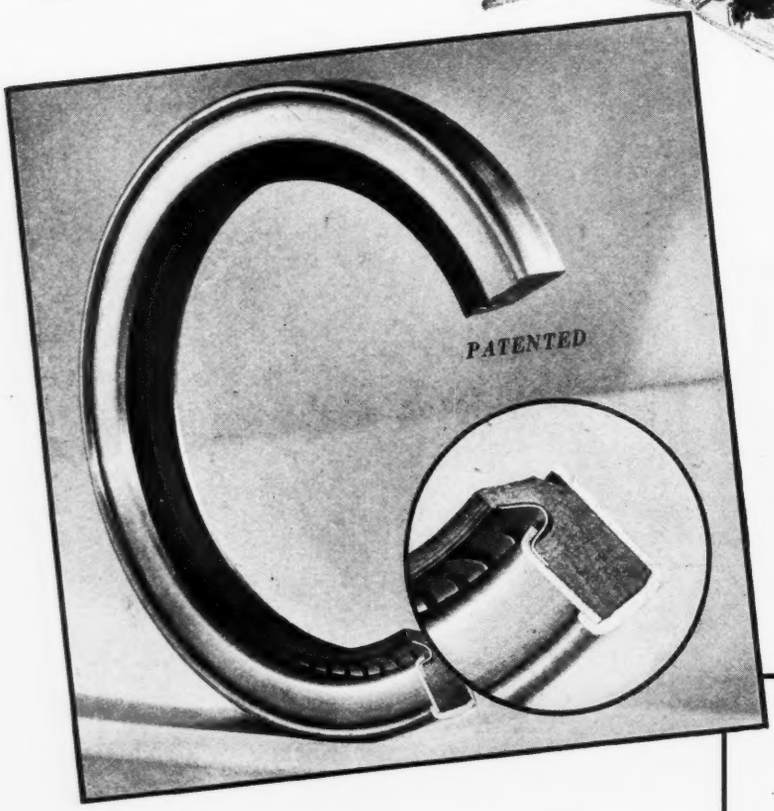
PRATT & CADY

DIVISION · BRIDGEPORT · CONNECTICUT

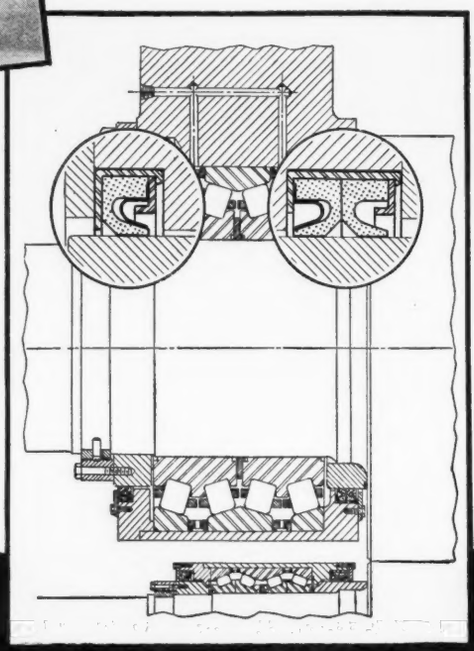
AMERICAN CHAIN & CABLE COMPANY, Inc.

AMERICAN CHAIN DIVISION • AMERICAN CABLE DIVISION • ANDREW C. CAMPBELL DIVISION • FORD CHAIN BLOCK DIVISION • HAZARD WIRE ROPE DIVISION • HIGHLAND IRON AND STEEL DIVISION • MANLEY MANUFACTURING DIVISION • OWEN SILENT SPRING COMPANY, INC. • PAGE STEEL AND WIRE DIVISION • READING-PRATT & CADY DIVISION • READING STEEL CASTING DIVISION • WRIGHT MANUFACTURING DIVISION • IN CANADA: DOMINION CHAIN COMPANY, LTD. • IN ENGLAND: BRITISH WIRE PRODUCTS, LTD. • THE PARSONS CHAIN COMPANY, LTD. • *In Business for Your Safety*

THEY CAN "TAKE IT"!



—So Can KLOZURE Oil Seals

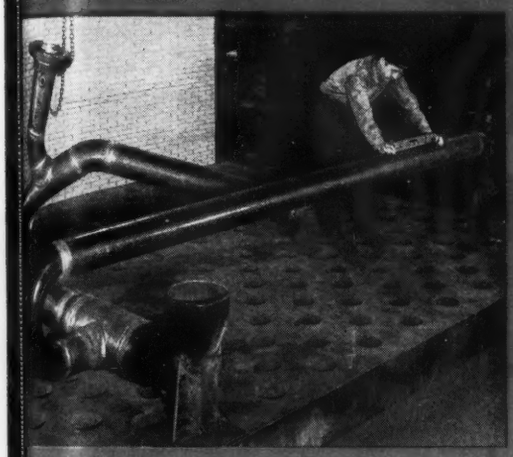


DRAGGING a heavy sledge over the ice and snow of the Arctic, a team of "huskies" will cover 60 miles day after day under the most trying conditions. The GARLOCK KLOZURE Oil Seal can "take it," too, under the most trying conditions . . . on "roll necks" in the steel mills, for instance, to mention only one of many successful applications in severe service. The exclusive GARLOCK compound from which the KLOZURE seal is made, is tough and durable . . . resists oil and heat at high or low temperatures. Write for catalog.

THE GARLOCK PACKING COMPANY, PALMYRA, N.Y.
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

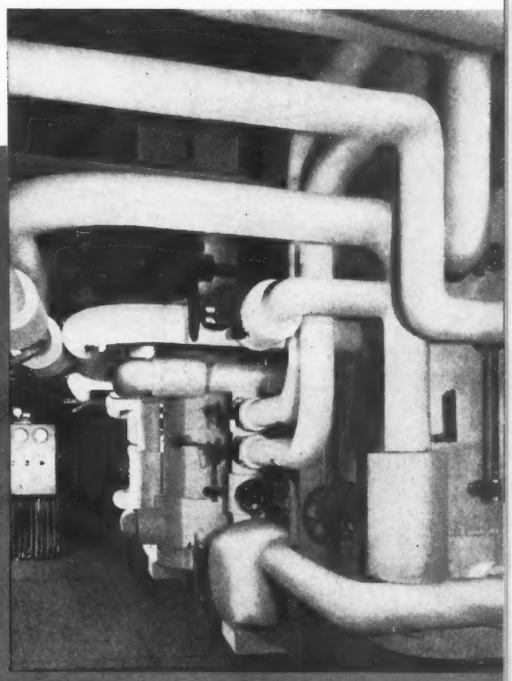
GARLOCK

EVERY KIND OF PIPING
IS OUR PRODUCT . . .
EVERY KIND OF EXPERIENCE
IS BEHIND OUR NAME

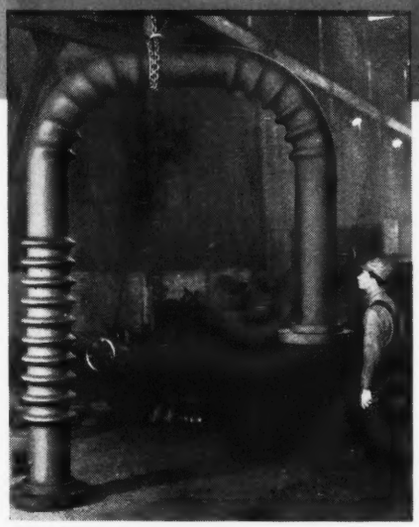


Expert workmen prefabricate sub-assemblies under controlled shop conditions where there are complete facilities for heat treating and insurance inspection.

Pittsburgh Piping's Alloy Division fabricates stainless exclusively. This specialization guarantees better and more efficiently fabricated stainless piping.



Fabricating high pressure, high temperature piping requires highest degree of skill and advanced shop technique. Many of the country's foremost power plants of this type have been prefabricated and erected by Pittsburgh Piping.



Because of their inherent flexibility, Pittsburgh Piping Creased Bends and Corrugated Tangents will reduce stresses and permit more compact piping design.

The design, fabrication and erection of modern steam and process piping systems has become a highly specialized task, requiring skilled engineers, mechanics and erectors. Pittsburgh Piping's engineering staff is thoroughly experienced in both the theoretical and practical phases of industry's piping requirements and problems. In its 5 acre plant, expert workmen prefabricate every conceivable type of piping. Erection crews are specially trained for rapid and efficient field installation of piping sub-assemblies. This combination of mature experience and adequate facilities is your assurance that your piping requirements will be fabricated and erected efficiently and economically.

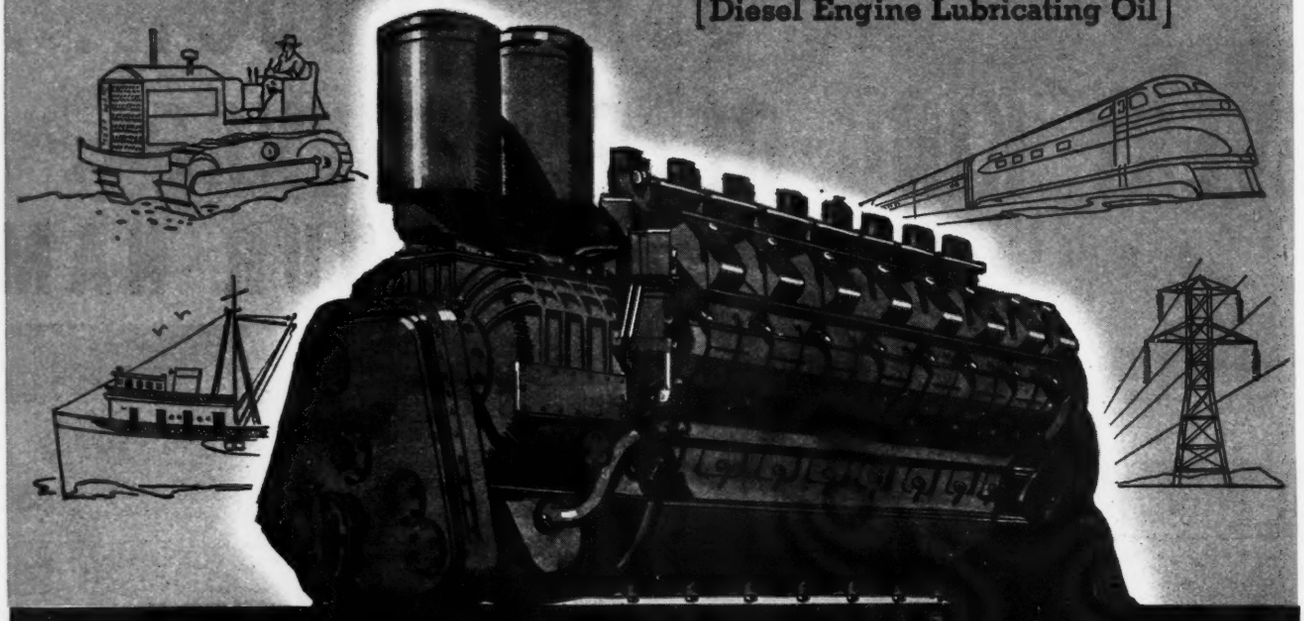
PITTSBURGH PIPING & EQUIPMENT CO., 10 FORTY-THIRD ST., PITTSBURGH, PA.

Woolworth Bldg., New York — Occidental Bldg., Indianapolis — Peoples Gas Bldg., Chicago — General Motors Bldg., Detroit
Public Sq. Bldg., Cleveland — 1st Nat'l Bank Bldg., Charlotte — 10 High St., Boston — 525 Market St., San Francisco

Pittsburgh Piping

NEW "RPM" DELO

[Diesel Engine Lubricating Oil]



Pushes Diesel performance UP
Pushes Diesel costs DOWN

We know that NEW "RPM" DELO means unequaled lubrication for all Diesel engines regardless of size, speed or type of bearings and its day-in, day-out performance in commercial operation backs us up.

It has traveled twice the distance 'round the world in 73 days on a mile-a-minute schedule—run thousands of hours in stationary Diesels at *full brake horsepower*—worked 24-hour shifts in automotive equipment, and marine engines, too.

The results? Ring sticking ended! Carbon, sludge and other deposits from previously-used oils cleaned out in engine after engine! Alloy-bearings free from corrosion! Oil filters clean! Pistons, rings, cylinders, bearing surfaces in new engines broken in to super-smooth finish! *AND*—

Not only has NEW "RPM" DELO pushed wear rate way down—it also has reduced fuel consumption and exhaust temperatures materially. Better engine operation! Lower costs!

Take a tip from these actual service results confirming our 10 years—10,000,000 miles of testing—

NEW "RPM" DELO is today's unequaled lubrication buy for your Diesel engines.

New "RPM" Diesel Engine Lubricating Oil now available everywhere in the gray barrel with the blue head

RPM
REG. TRADE MARK
DIESEL ENGINE LUBRICATING OIL

Order from Your Nearest Distributor as Listed Below:

IN THE UNITED STATES

"RPM" Diesel Engine Lubricating Oil:
The California Company (Montana only)
Humble Oil & Refining Company
Standard Oil Company (Indiana)
Standard Oil Company (Nebraska)
Standard Oil Company of California
Standard Oil Company of Texas
Utah Oil Refining Company

Diol "RPM" Diesel Engine Lubricating Oil:
The Carter Oil Company
Tulsa, Oklahoma
Colonial Beacon Oil Company
Standard Oil Company of Louisiana
Standard Oil Company of New Jersey
Standard Oil Company of Pennsylvania

Kyso "RPM" Diesel Engine Lubricating Oil:
Standard Oil Company (Inc. in Kentucky)

Signal "RPM" Diesel Engine Lubricating Oil:
Signal Oil Company

Sohio "RPM" Diesel Engine Lubricating Oil:
The Standard Oil Company (Ohio)

IN CANADA AND NEWFOUNDLAND

New Imperial "RPM" Diesel Engine Lubricating Oil:
Imperial Oil Limited

IN BRITISH COLUMBIA, ALBERTA AND SASKATCHEWAN

New "RPM" Diesel Engine Lubricating Oil:
Standard Oil Company of British Columbia Limited

THROUGHOUT THE WORLD

"RPM" Diesel Engine Lubricating Oil is available through distributors in more than 100 countries.

STANDARD OIL COMPANY OF CALIFORNIA

HERE IS YOUR GUIDE TO PROPER VALVE SELECTION

Two basic valve types—gate and globe—are most commonly used in conveying industrial fluids and gases. Both types, in their many variations, are designed to give dependable flow control. Yet, each type has distinct features that may be an advantage or disadvantage in the efficiency of a given application. And that depends wholly upon the service conditions involved.

The Crane Bulletin—"Service Characteristics of Gate Valves and Globe Valves," with its Valve Selection Guide helps you avoid misapplication of valves. It shows you the way to low-cost valve maintenance. Get a free copy from your Crane Representative—or, write for one today.

YOUR PIPING COSTS STAY DOWN *when valves are properly chosen*

IT'S amazing, in many cases, how piping maintenance costs are reduced when troublesome valves are replaced. It's surprising, too, what a difference properly selected valves make in giving you low-cost, dependable flow control.

The reason is simple. In the broad line of valves offered to industry today, there is one that is best suited to each specific application—one that exactly matches working conditions.

Perhaps service conditions in your lines vary slightly—do not appear important, or deserving of special attention. Yet economical valve performance begins only with proper valve selection; and every variable of service influences valve choice.

Perhaps individually, maintenance of your valves does not seem excessive, and is overlooked. But consider it in terms of all the valves in your plant—and in terms of operation interruptions. Your findings may be astonishing.

Because experience is the best means of gauging piping costs, Crane can help you keep them at a minimum. With a successful background in solving industry's piping problems, with unparalleled research and plant facilities, and with over 84 years of manufacturing skill, Crane has developed so complete a line of valves that every need can be filled with Crane-Quality equipment.

And because Crane-Quality is the result of extreme accuracy in manufacture, of careful analysis and specification of materials that go into each part, Crane valves assure the long, economical service that keeps piping costs down.

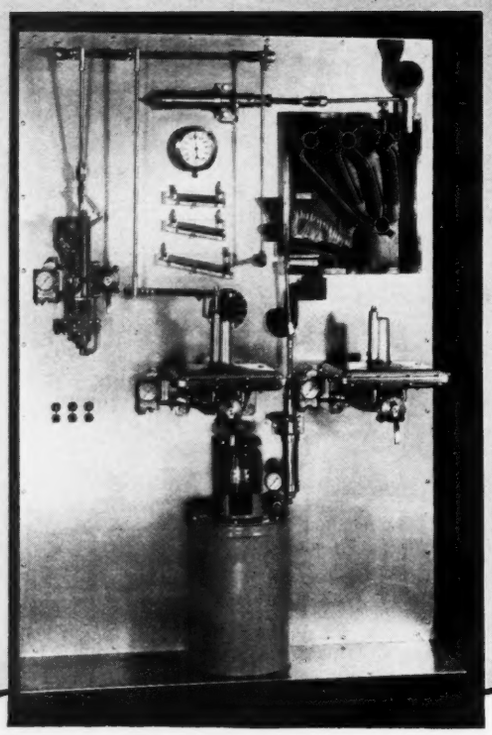
Backed by the Crane line of more than 38,000 piping items, your Crane Representative can help you solve your flow control problems. Call him today.

CRANE

CRANE CO., GENERAL OFFICES
836 S. MICHIGAN AVE., CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS



Automatic Combustion Control need not cost you

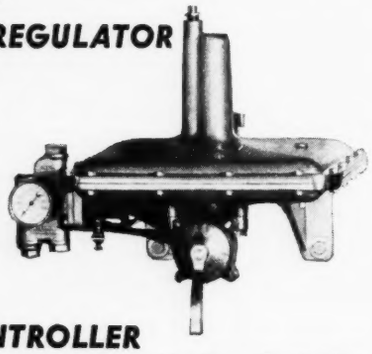
A LOT OF MONEY . . . . . .

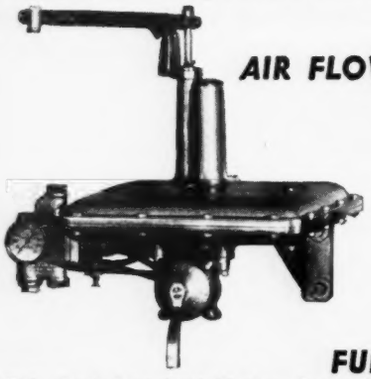
You can start by installing the Furnace Draft Controller alone . . . for as little as $98.00 if you want to

And begin to get its money-saving benefits right away. Since it works independently, you can add the rest of the system later.

FURNACE DRAFT REGULATOR

This Cash Standard Furnace Draft Regulator works from over-fire draft, regulating the boiler up-take damper, to maintain a constant draft in the combustion chamber. Place it near the up-take damper. It works independently of either of the two Controllers shown below. It does its part toward money saving by eliminating wasteful air infiltration.



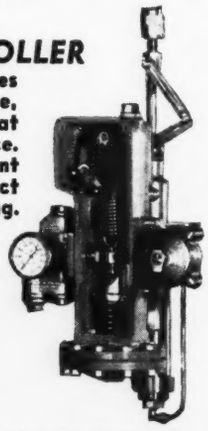


AIR FLOW CONTROLLER

This Cash Standard Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler doing its part to insure perfect combustion.

FUEL FEED CONTROLLER

This Cash Standard Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion; keeping the correct fuel-air ratio for perfect combustion — hence, money saving.



OIL CIRCULATOR

The purchase of this oil circulator is optional. The regulator and two controllers shown above can be properly operated by clean water, but it is preferable and cheapest in the long run to operate this equipment with this Cash Standard Oil Circulator, price $108 equipped with 110/220 v. 60 cy. motor.

Find out more about installing Automatic Combustion Control without great investment on your part — understand more fully how Cash Standard Control Systems work and what they will do to save money for you. Write for Bulletin 963-A-B.

Is the other part expensive?

Not at all! To make the system complete for one boiler you can get Fuel Feed Controller, Air Flow Controller with Operating Power Cylinders included (as in the Furnace Draft Regulator), and necessary connecting fittings, all for as little as $290.

And these are precisely the same control units that we furnish on the most elaborate kind of job, and for the largest kind of boilers. Of course, this money-saving plan is based on your installing the control units conveniently near the apparatus they operate, without panel board.

If, as an extra, you want the Hand Control Valves shown on each of the controllers in these cuts, they cost $30 each, installed on the controllers.

Of course, Cash Standard Control Systems come on panel boards if you want them; but they work just as well with the Control Units mounted individually elsewhere. The cut above shows a portable display panel on which full size Control Units (with miniature boiler) work automatically to show the real sensitivity, accuracy, and dependability of the Cash Standard System.

A. W. CASH COMPANY

Decatur, Illinois

CASH STANDARD CONTROLS . . VALVES

Why it Pays

TO STANDARDIZE ON

Linde Products

THE Linde organization can supply *all* your oxy-acetylene needs. For this reason, it usually pays dollars-and-cents returns to standardize on Linde products.

By buying from Linde, you can centralize your source of supply — can look to just one responsible organization to fill your requirements. Your bookkeeping and ordering often can be simplified, your cylinder and materials handling made easier, your investment in parts and equipment reduced.

Even more important, Linde can furnish process help which will contribute to the technical skill and knowledge of your operators — can show you how and where to apply new Linde processes — and can help you control your process costs.

The Linde man who calls on you will gladly explain in detail exactly how and why Linde customers are getting the most for their money. The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation, New York and Principal Cities.

PLUS VALUES

N SERVICE—Linde akes available to its stomers real, tangible, ocess service that helps ing highest returns from inde products.

IN MEN—The Linde men who call on you are highly trained. They are coordinating factors between you and Linde's extensive engineering facilities.

IN PROCESSES—Linde laboratory men are continually developing new ways to help customers do a better job—in less time — at lower cost.

NDE OXYGEN · NITROGEN · HYDROGEN · RARE GASES · PREST-O-LITE ACETYLENE
NION CARBIDE · OXWELD APPARATUS AND SUPPLIES · UNIONMELT WELDING

words "Linde," "Union," "Prest-O-Lite," "Oxweld" and "Unionmelt" are trade-marks.

IT PAYS ON OXYGEN

Linde oxygen is of uniform high purity. It is available in any quantity when and where you want it — at a price that is always fair.

IT PAYS ON ACETYLENE

Prest-O-Lite dissolved acetylene is the convenient, all-purpose, fuel gas for welding, cutting, or any related process. It can be delivered by the same truck that brings your Linde oxygen.

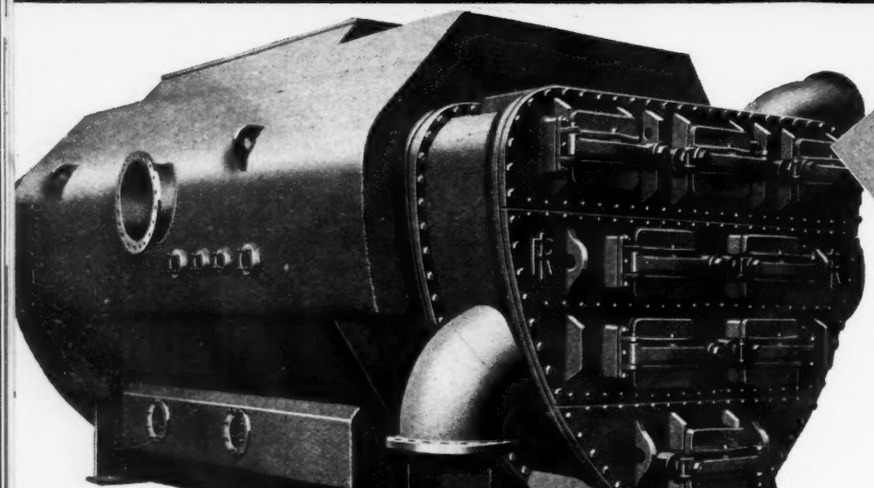
IT PAYS ON CARBIDE

For customers who generate their own acetylene, Union Carbide—sold in the familiar blue-and-gray drums—assures uniformity, accurate sizing, purity, highest gas yield.

IT PAYS ON APPARATUS

Linde has a complete line of precision-built apparatus and supplies for every oxy-acetylene application. Blowpipes — regulators — manifolds — generators — cutting machines.

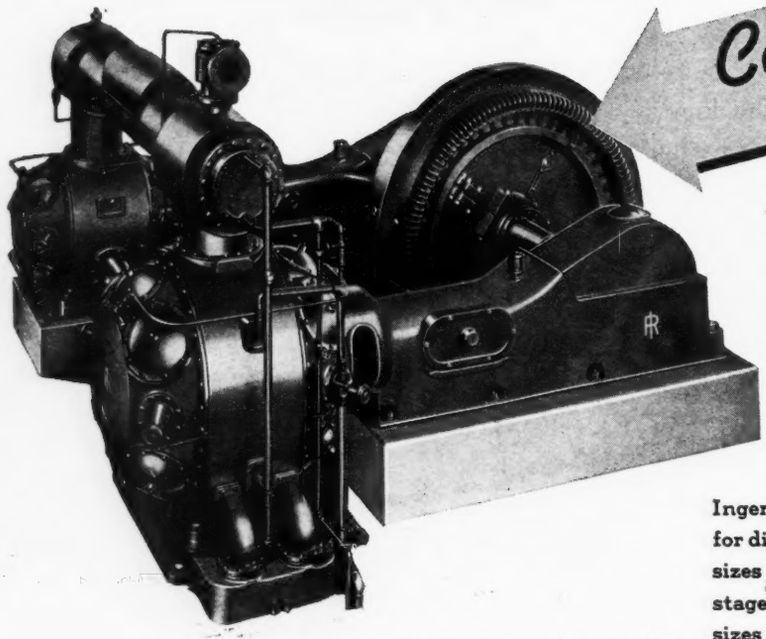
Buy I-R EQUIPMENT for Economy and in



Condensers

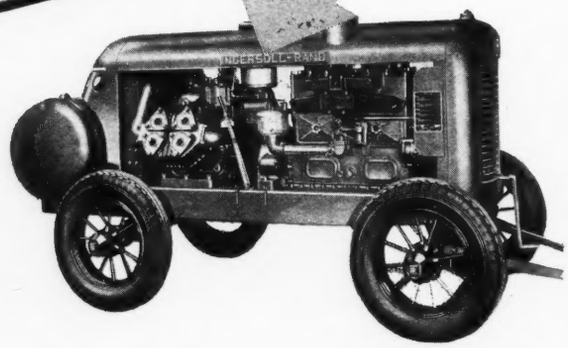
Surface and Barometric types

I-R high efficiency surface and barometric condensers are the acknowledged standard of the power industry. Sizes up to 160,000 kw. Ingersoll-Rand also builds single and multi-stage steam jet ejectors.



Compressors

Sizes 1/4 to 3000 hp

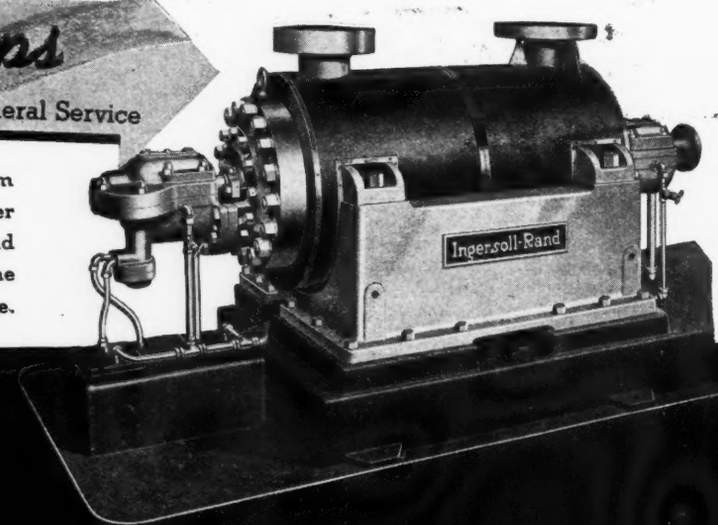


Ingersoll-Rand compressors are available in all sizes and types for direct-connected or belted motor drive. There are also many sizes with built-in steam, Diesel, or gas power cylinders. Two-stage air-cooled portable units are available in all standard sizes and mountings with either gasoline or oil engine drive.

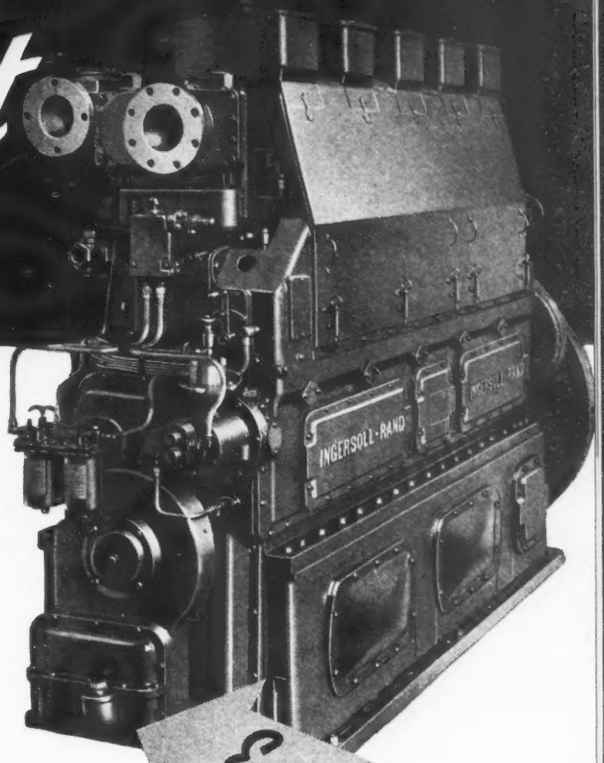
Pumps

Boiler Feed and General Service

Multi-stage boiler-feed pump capacities range from 20 to 3000 gpm and pressures up to 3000 lbs. Other special purpose pumps are available for hot-well and circulating service. The Motorpump is one of the many I-R general service pumps for power plant use.



Efficiency your Power Plant!

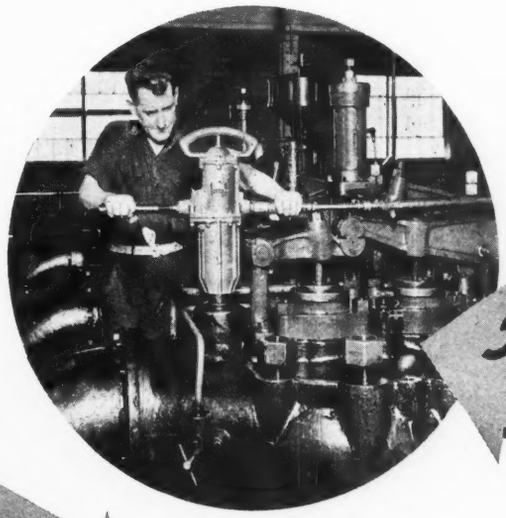


EACH I-R unit is the result of careful research and long manufacturing experience—into each is built those features which protect the reliability of your operating setup and add to its economy and efficiency.

In selecting I-R equipment, you have the satisfaction of buying from power plant specialists. Your choice will be made from a complete line of up-to-the-minute products—each of which has established its claim to leadership. The local I-R representative has the full facts, and his knowledge and experience will help you in selecting the correct units for your installation.

Engines
Diesel and Gas

Type S Vertical Diesel, 3 to 8 cylinders, 190 to 510 bhp at 600 rpm; Type SG Convertable Gas-oil Engine, 190 to 510 bhp; Gas Engines, 185 to 650 bhp. All are built and rated for continuous full-load service.

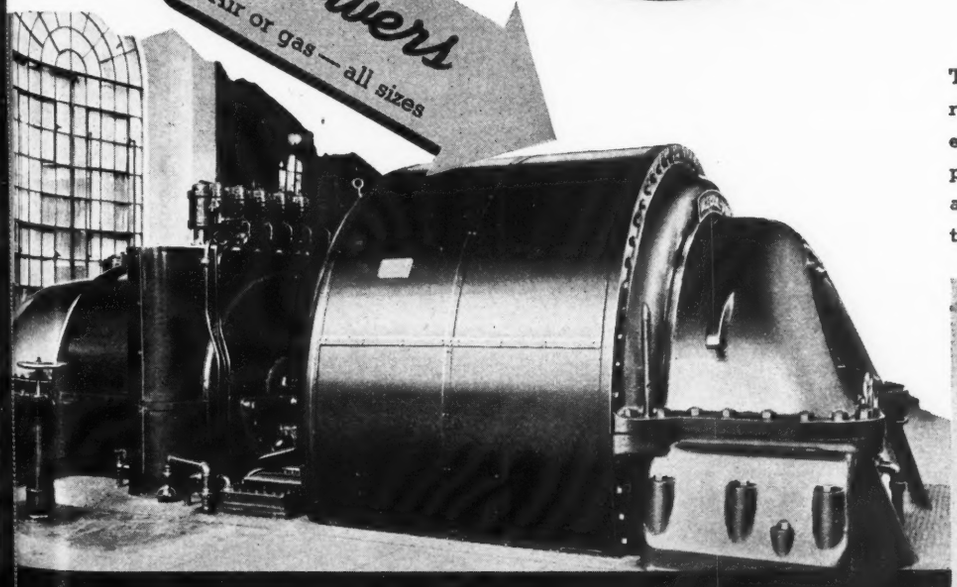


I-R turbo blowers are made in sizes from 3 to 12,000 hp, for handling air or gas at all industrial pressures and in volumes up to 100,000 cfm.

Impact Wrenches
And other pneumatic tools

The I-R Impact Wrench has no equal for removing or applying nuts, staybolt caps, studs, etc. Other I-R pneumatic tools include complete lines of hoists, drills, grinders, chipping and riveting hammers, as well as all sizes and types of rock drills and paving breakers.

Blowers
Air or gas—all sizes



Ingersoll-Rand

11 BROADWAY, NEW YORK CITY

Birmingham	Detroit	Philadelphia
Boston	Duluth	Pittsburgh
Buffalo	El Paso	Salt Lake City
Butte	Knoxville	San Francisco
Chicago	Los Angeles	Scranton
Cleveland	Newark	Seattle
Dallas	New Orleans	St. Louis
Denver	New York	Washington

Branches or distributors in principle cities the world over

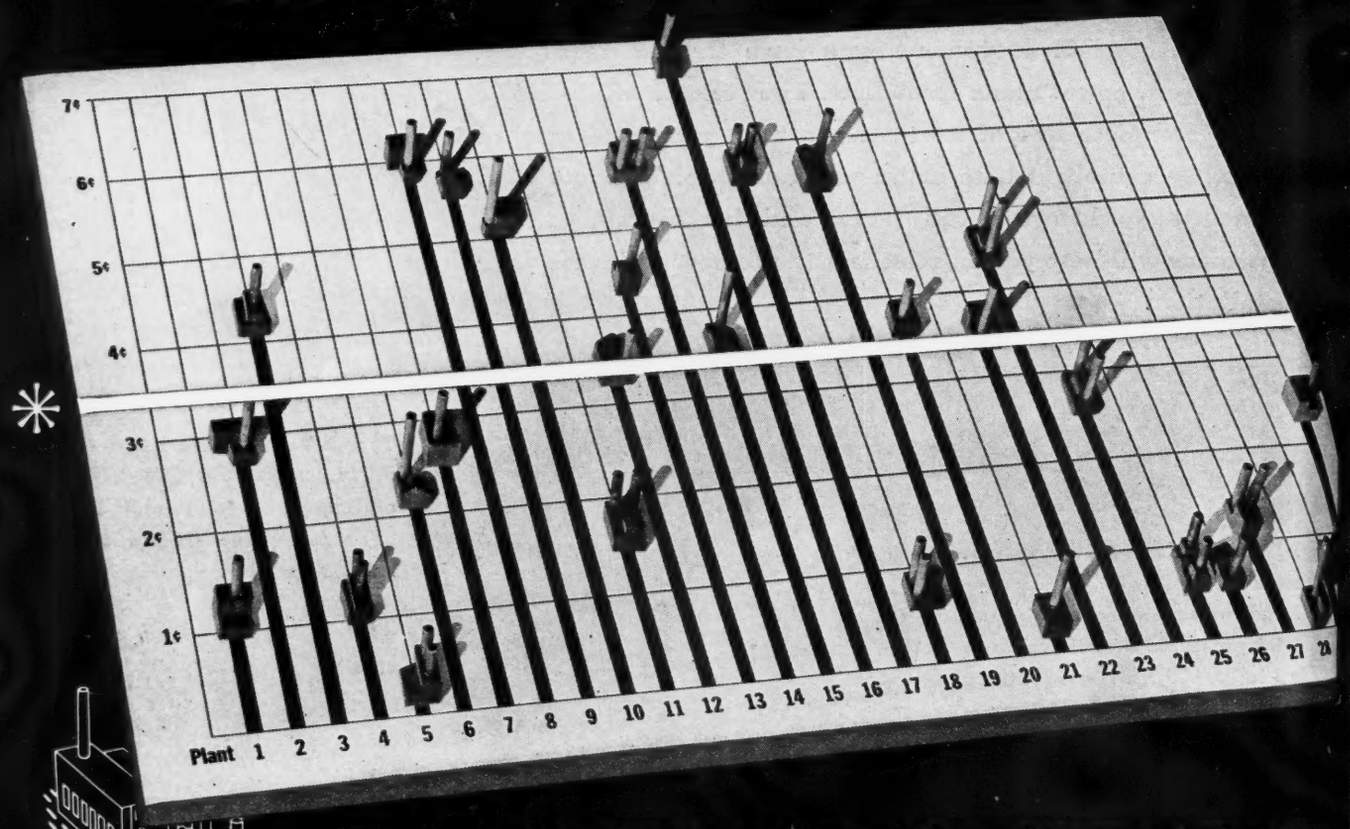
London	Tokyo	Valparaiso
Paris	Lima	Rio de Janeiro
Madrid	Santiago	Sao Paulo
Vienna	Buenos Aires	Brussels
Johannesburg	Montreal	Bombay
Calcutta	Mexico City	Stockholm
	Havana	

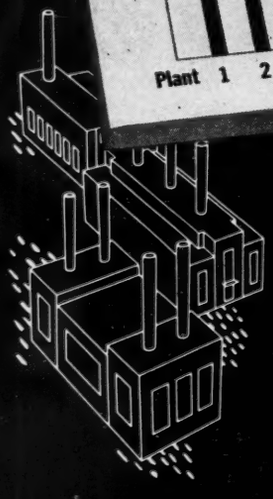
834-14

MAINTENANCE

* *AVERAGE maintenance for 5,762,822 tons—*

3.39¢ *per ton*





This chart is a true cross section of the maintenance cost records of Taylor Stoker installations. High as well as low points are shown over widely diversified operating conditions in thirty plants, comprising 12 industrials, 5 municipals, 5 institutionals, 6 utilities, and 2 heating plants. The range of coal consumption is from 2,000 to 500,000 tons per year. Significant is the number of plants operating below the average line—an accomplishment which is not difficult to attain. Why not ask an A-E-CO representative to give you ALL the facts? American Engineering Co., Aramingo Avenue, Philadelphia, Pa.

AMERICAN E

A-E

Illustration shows how the A-E-CO Taylor Stoker is protected by green coal.

GET THE FACTS ABOUT

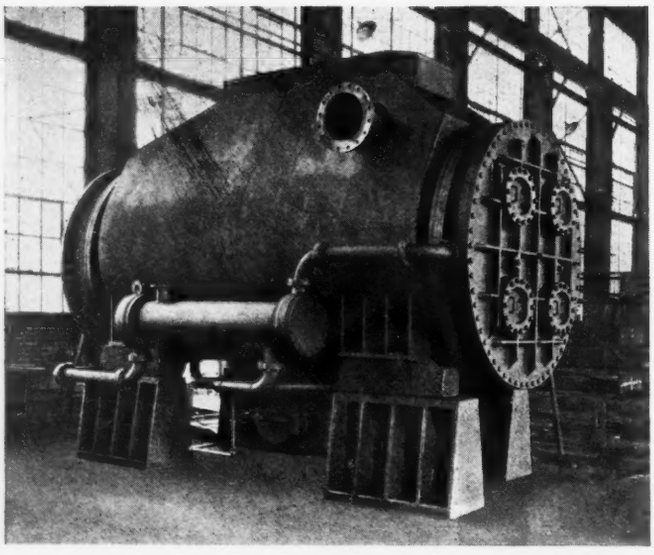
- Reliability
- Capacity
- ★ Maintenance
- Flexibility
- Efficiency
- Operation
- Adaptability
- Fuel Flexibility
- Refuse Disposal
- Stack Discharge
- Space Requirements
- Obsolescence

THE A-E-CO Taylor Stoker

A-E-CO Water Walls

ENGINEERING COMPANY

A-E-CO Taylor Stokers, Water Walls, Ash Hoppers, Lo-Hed Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power



Condensers

Unit responsibility—centralized engineering—complete fabrication.

From large welded and stress-relieved shells to small condenser tubes, Foster Wheeler controls the design, fabrication and construction of its condensers. No other condenser manufacturer in the United States operates its own condenser tube mill.

Many of the widely accepted principles of condenser engineering have been pioneered by Foster Wheeler including converging tube spacing, tubes expanded at each end and reverse flow design.

FOSTER WHEELER CORPORATION

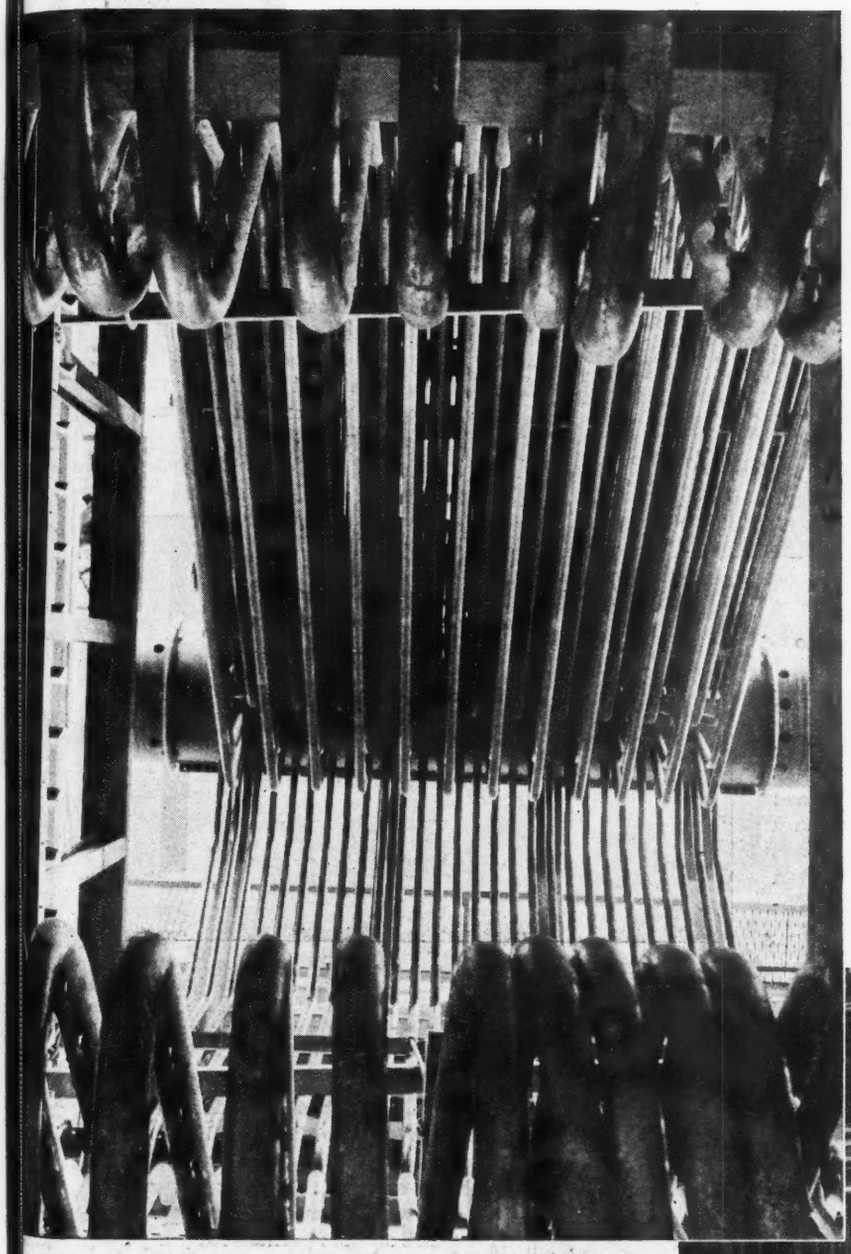
165 Broadway New York, N. Y.

FOSTER FW WHEELER

ELECTRUNITE

REG. U. S. PAT. OFF.

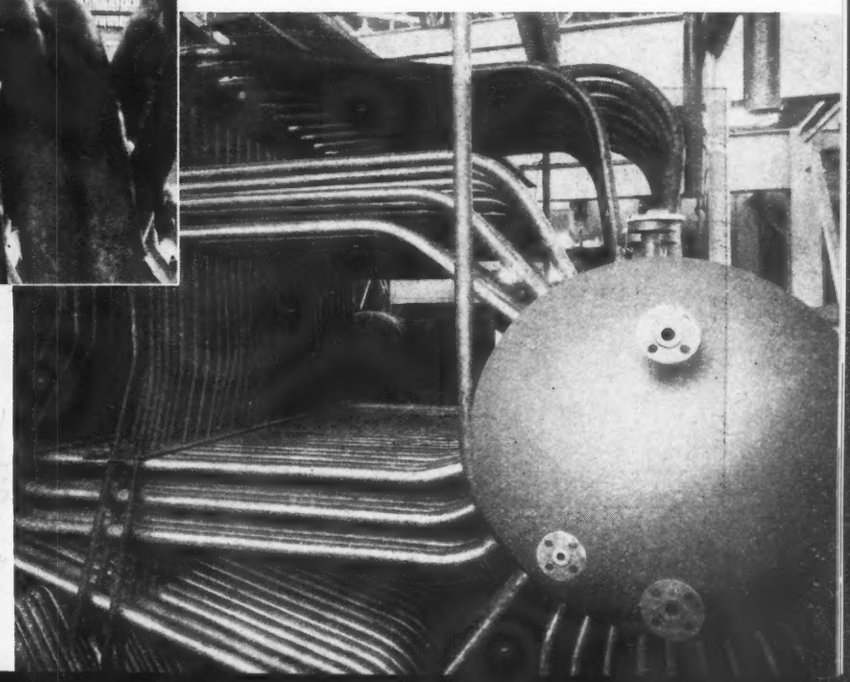
THE MODERN ELECTRIC RESISTANCE WELDED BOILER TUBES



● Engineered by E. M. Gilbert Engineering Co. and built by Foster Wheeler Corp. for the New York Gas and Electric Co., this 110,000 pounds per hour, 725 pounds pressure and 825°F. temperature steam generator is tubed with ELECTRUNITE.

Again, these modern tubes have been selected for an outstanding boiler job. Again, according to their past performance records in other installations, they will show the way to sound, safe, low-cost boiler operation.

Take advantage of the consistent uniformity of ELECTRUNITE—and the savings these ductile, fine-surfaced tubes make possible. Use them for all types of heat transfer equipment. Ask your jobber or write us for detailed information.



Steel and Tubes Division

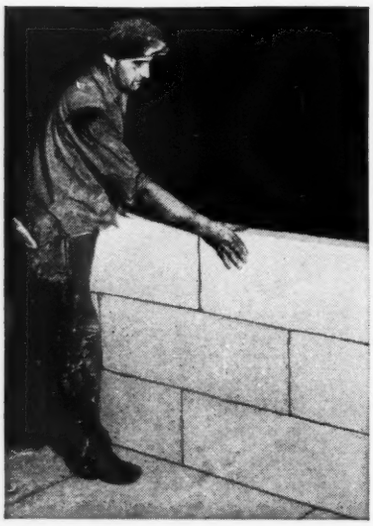
REPUBLIC STEEL CORPORATION

CLEVELAND • • • • OHIO

3-WAY COMBINATION FOR

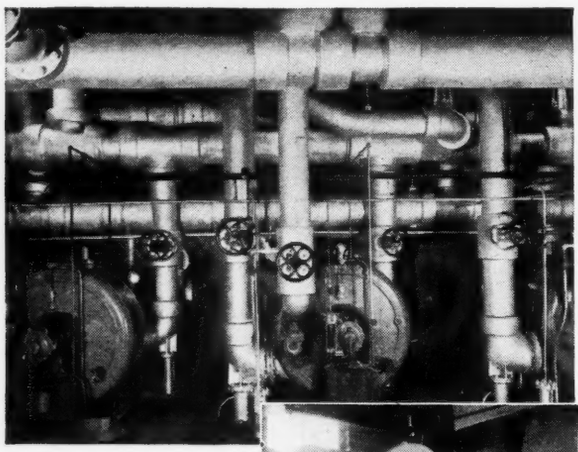
Durable and unusually efficient, these J-M Power Products last longer with less maintenance . . . give improved performance wherever used . . .

1 J-M INSULATIONS



ON BOILERS . . .

Where insulation is required to resist temperatures between 600° and 1900°, J-M Superex Blocks are ideal. Even under severe operating conditions, this durable material gives long, efficient service . . . offers maximum protection against costly heat losses.

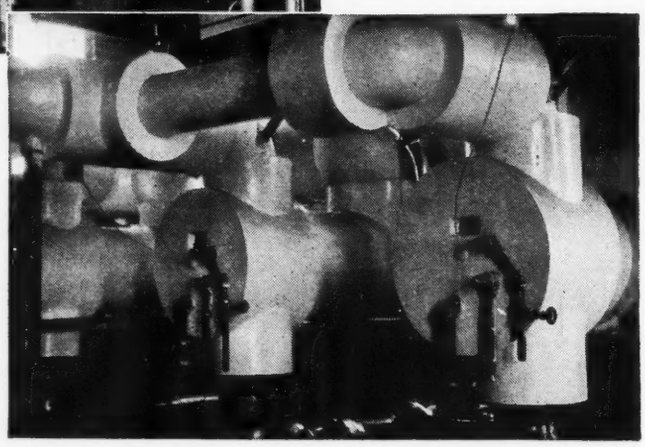


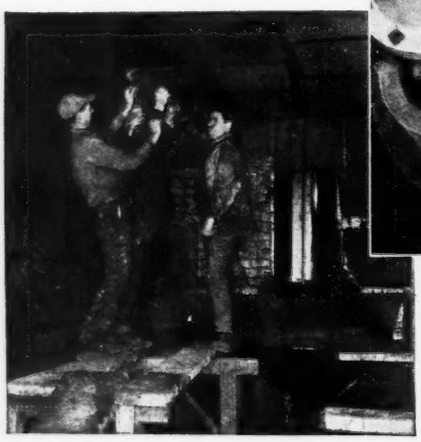
ON SUPERHEATED STEAM LINES . . .

Johns-Manville Superex Combination Insulation provides an effective safeguard against excessive heat waste. Built up of Superex and J-M 85% Magnesia, it offers exceptional heat resistance and unusually high insulating value.

FOR LINES UNDER 600°

. . . You save money by using J-M 85% Magnesia Pipe Insulation. For many years the standard insulation for steam lines, it combines light weight with high insulating efficiency.





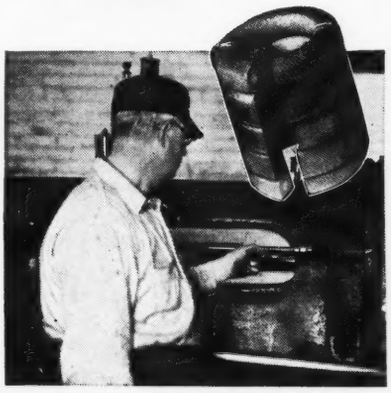
FOR LOW TEMPERATURES

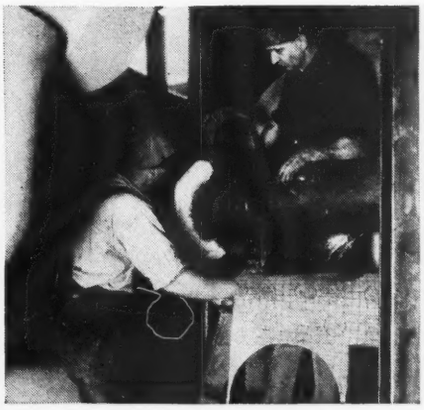
. . . J-M Rock Cork has been giving low-maintenance service for more than thirty years. Supplied in both sheet and pipe-covering form, it is basically mineral . . . does not burn, rot or decay. Unusual moisture-resistance assures permanently high insulating efficiency.

JM JOHNS-MANVILLE

LOWER POWER-PLANT COSTS

2 J-M PACKINGS AND GASKETS





AGAINST STEAM, AIR, BRINE, OIL . . .

J-M Sea Rings are ideal for rods and plungers. Entirely automatic, they seal on work stroke, release on return . . . minimize rod wear.

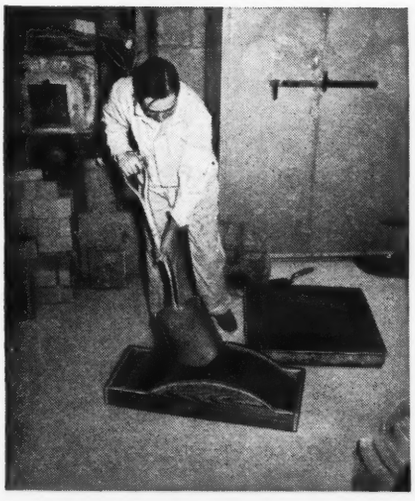
ON FLANGES . . .

and other parallel surfaces, it will pay you to use J-M Service Sheet. It is dense, yet resilient . . . always uniform in quality. Stocks may be carried indefinitely, for it does not deteriorate with age.

FOR BOILER HANDHOLES AND MANHOLES . . .

J-M Kearsarge Gaskets form perfect seals every time. Made of specially treated Asbesto-metallic cloth, they assure long life, low maintenance.

3 J-M REFRACTORY PRODUCTS



FOR BONDING . . .

You get strong, tight joints with these J-M Refractory Cements: Hellite, air-setting—for bond or cushion joints; No. 31, heat-setting—for bond or cushion joints; No. 32, heat-setting—for brick-to-brick joints. Hellite and No. 32 also used for washcoating.

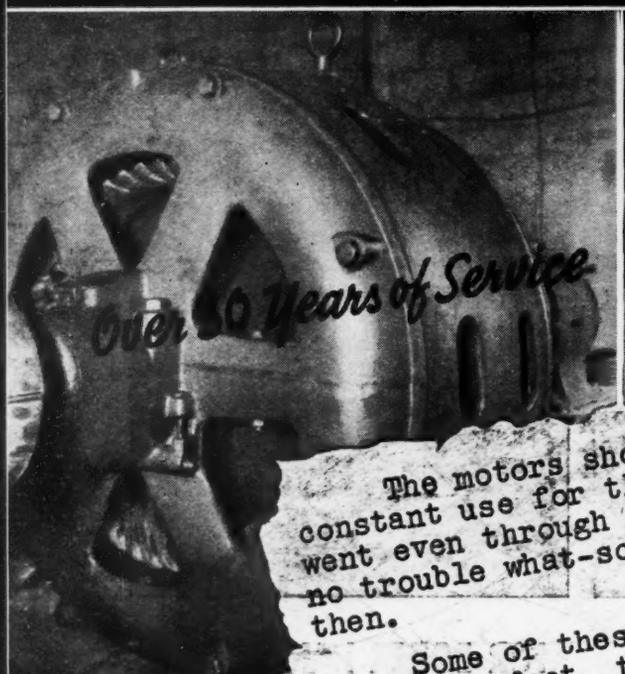
FOR SPECIAL SHAPES . . .

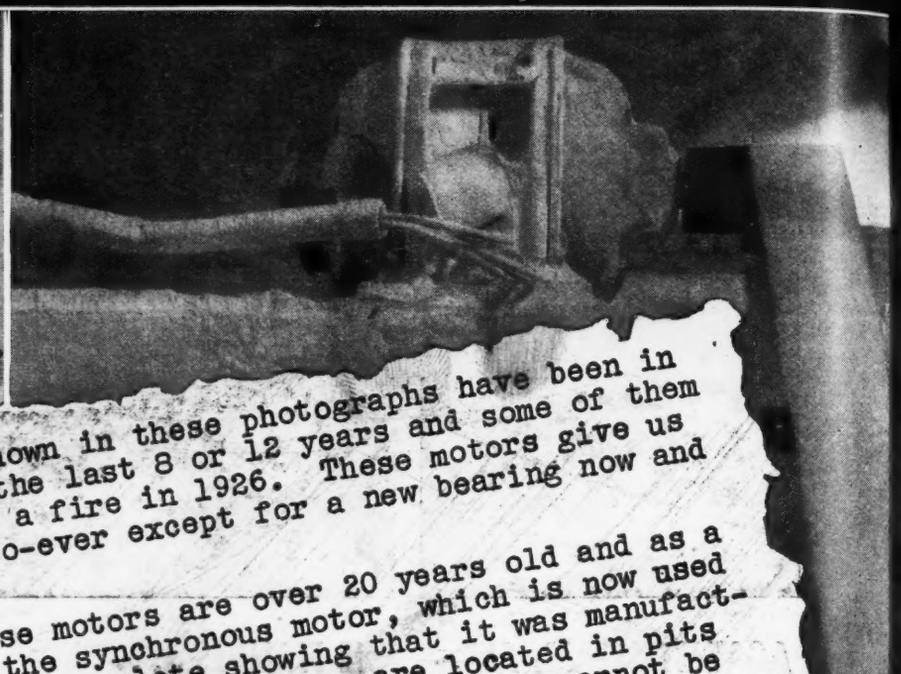
Cast your own shapes with J-M Firecrete. Air-sets, handles like concrete, forms any shape. Also ideal for poured door linings. 3 types: Standard (2400°), High Temp. (2800°), Light Weight (2200°).

POWER PRODUCTS

These well-known J-M materials are saving money for thousands of plants all over the country. The materials shown on these pages represent only a small part of the complete J-M line of Power Products. You should have full details on them all. Write for catalog GI-6A. Address Johns-Manville, 22 E. 40th St., New York, N. Y.

Marble Dust! Fire! Time!



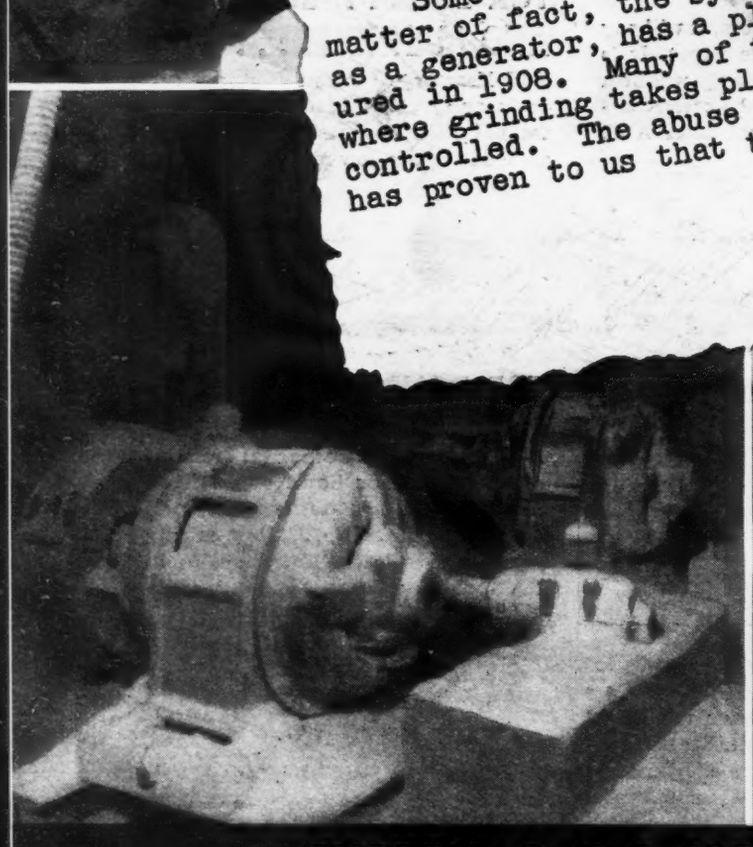


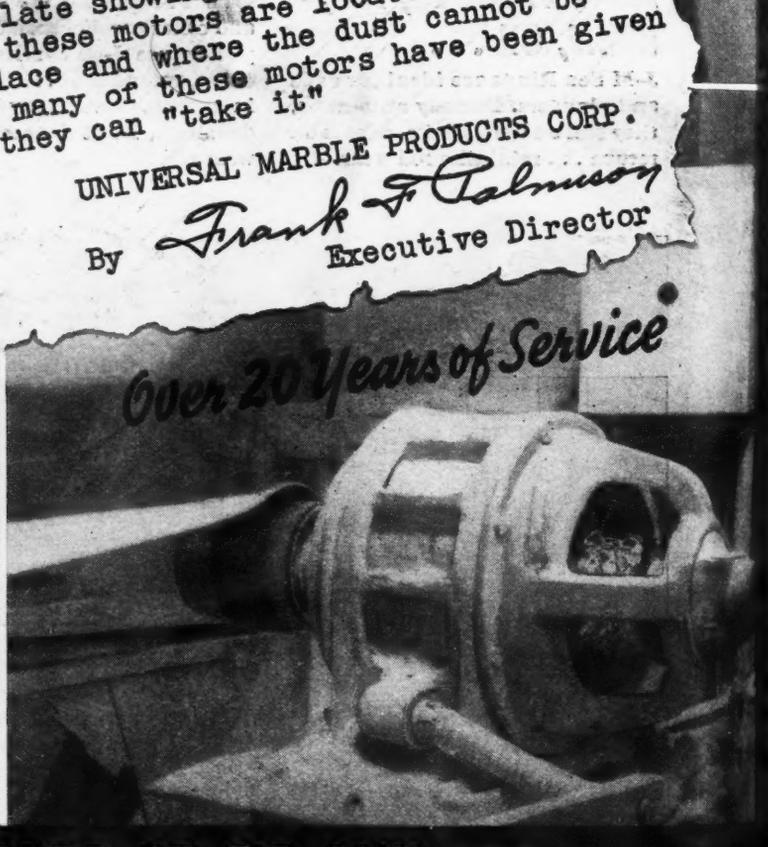
The motors shown in these photographs have been in constant use for the last 8 or 12 years and some of them went even through a fire in 1926. These motors give us no trouble what-so-ever except for a new bearing now and then.

Some of these motors are over 20 years old and as a matter of fact, the synchronous motor, which is now used as a generator, has a plate showing that it was manufactured in 1908. Many of these motors are located in pits where grinding takes place and where the dust cannot be controlled. The abuse many of these motors have been given has proven to us that they can "take it"

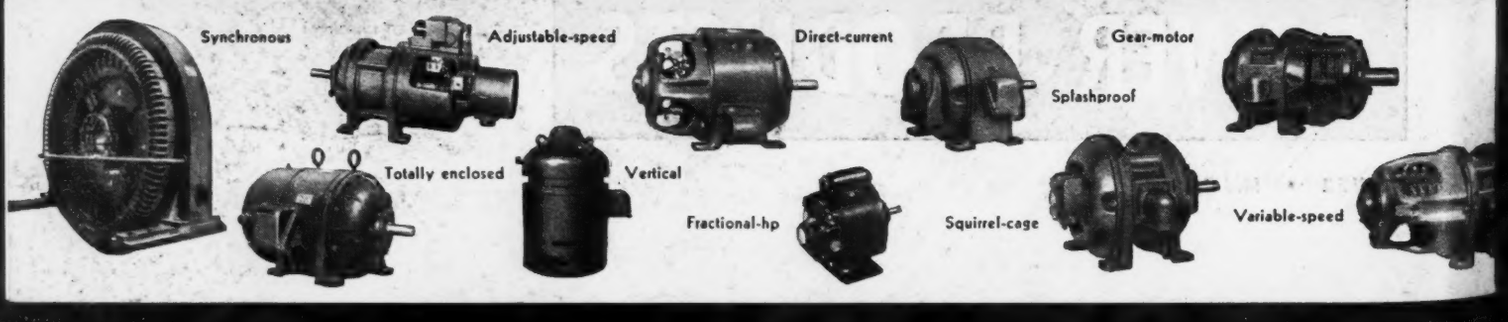
UNIVERSAL MARBLE PRODUCTS CORP.

By Frank F. Palmson
Executive Director





THERE'S A G-E MOTOR TO FIT ANY JOB



-Test G-E MOTORS

At Universal Marble Products Corp.

Read What Mr. Palmison Says About How They Passed These Tests

THE statement on the opposite page from Mr. Palmison, Executive Director of the Universal Marble Products Corp. at Thornwood, N. Y., tells how G-E motors have been tested by marble dust, fire, and time. In spite of these severe conditions, the G-E motors have cost practically nothing for upkeep.

The dust alone is a severe test of motor insulation. Powdered dolomite and marble dust, products of this plant, are very abrasive. Totally enclosed motors would usually be recommended for such locations.

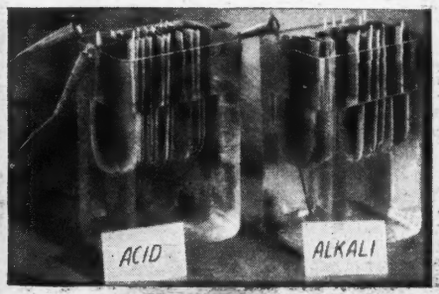
Open G-E motors, however, have not only stood up under the dust, but have passed through a fire, and have already turned in long operating records. They have, as Mr. Palmison says, given "no trouble whatsoever except for a new bearing now and then."

Why Is Such Performance Possible?

One reason G-E motors pass performance tests like this is the thorough testing at every point in their manufacture. Designs, materials, and the motors—both finished and in process—are all continually checked by numerous tests such as those shown below.

G-E motors are available in all sizes and types. When you need information on any type, call the nearest office of General Electric, the G-E Supply Corp., or G-E motor dealer. General Electric, Schenectady, New York.

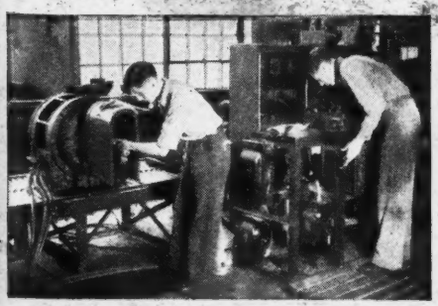
TYPICAL FACTORY TESTS ON G-E MOTORS



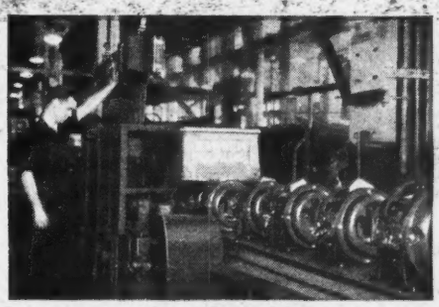
Acid and alkali tests prove that General Electric insulating varnish protects motor windings against mild corrosive agents

Abrasion test. This machine tests the resistance to abrasion of the enamel film on magnet wire used in G-E motors

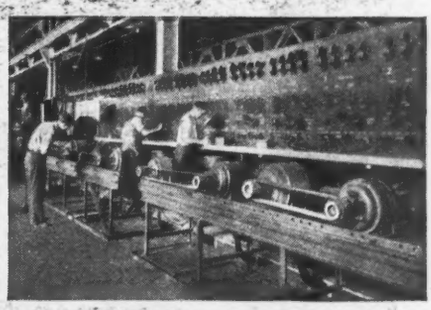
High-potential test No. 1 checks the stator windings of G-E motors before they are dipped in the insulating varnish



A complete electrical test is made on all motors before they leave production, even though they have already passed many tests



High-potential test No. 2 is likewise made on each motor to prove the dielectric strength of the insulation

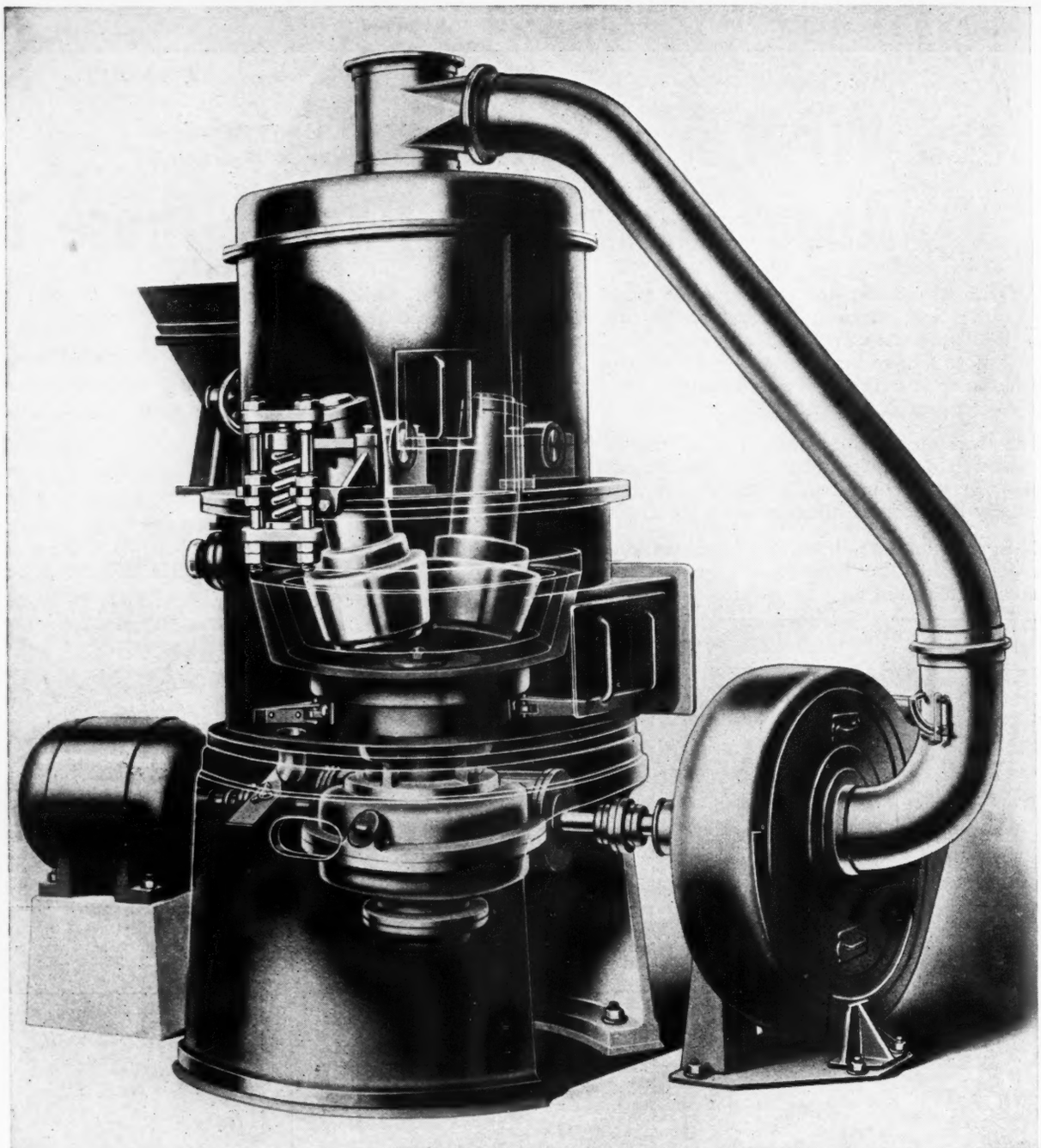


Punishing life tests on representative G-E motors include service more severe than any conditions motors normally meet

GENERAL ELECTRIC

020-302

1939 Buyers SELECT THE



C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

COMBUSTION

C-E RAYMOND BOWL MILL . . .

. . . for an aggregate grinding capacity of 1,119,250 lb per hr—purchased in the first 11 months of 1939

Since the Bowl Mill was introduced less than 5 years ago, it has set the standards for measuring pulverizer performance. Why—because it established higher standards than had ever been achieved before, a fact which has been demonstrated by extensive redesigning of competitive equipment. Each year since its introduction, the preference for the Bowl Mill on the part of experienced operating engineers has become more pronounced. Many of them have characterized it unqualifiedly as the finest pulverizer ever built.

And so it is not surprising that the capacity of Bowl Mills purchased for boiler firing in the first eleven months of 1939 has reached the impressive aggregate of 1,119,250 lb per hr.

2,550,000 TONS PER YEAR—If these mills on the average are required to operate at 80 per cent of their rated capacity for 65 per cent of the total hours in a year,—they will pulverize 2,550,000 tons of coal per annum. Applied to the production of electrical energy and assuming a coal consumption of 1 lb per kw-hr, these mills would pulverize enough coal to generate over 5 billion kw-hr annually, or about 10 percent of the entire coal-produced electrical energy sold by all utilities in 1938.

2 OUT OF 5 ARE REPEAT ORDERS—And still more significant is the fact that 38 per cent of 1939 Bowl Mill orders have come from companies that had previously purchased one or more of these mills. These companies know from their own experience and operating records what Bowl Mill performance will contribute to the overall efficiency, economy and reliability of their new steam generating units. They bought Bowl Mills on the basis of *known* rather than *hoped-for* results. Such a volume of repeat orders, especially for a product on the market less than five years, speaks for itself.

Because pulverizer performance is so large a factor in the success of pulverized-coal-fired boilers, it is of first importance that you buy the best pulverizing equipment available. Examine the advantages of Bowl Mill performance listed in the panel opposite and read the brief summaries of design, construction and operating features which make these advantages possible. You can get all of these advantages in fullest measure by specifying Bowl Mills for your next installation.

THESE FEATURES EXPLAIN

why industry has purchased in the first 11 months of 1939 Bowl Mills with an aggregate grinding capacity of 1,119,250 lb* of coal per hr.

WIDE CAPACITY RANGE—Output can be varied in small increments from minimum to maximum rating. Desired fineness easily maintained regardless of output.

SIMPLE OPERATION—Automatic feed, instantly adjustable. One standard constant speed motor for operating both mill and fan. Few parts and rugged construction insure freedom from mechanical troubles.

EFFECTIVE LUBRICATION—Positive oil circulation in main shaft bearings—gear mechanism running in oil—all operating parts can be lubricated from outside while mill is running.

CONTINUITY OF SERVICE—Mill capable of operating continuously at full load, month after month, without shutdowns. All adjustments may be conveniently made without stopping.

QUIETNESS—Elimination of metal-to-metal contact prevents pounding or vibration. Worm gear drive with ball bearings, main shaft with roller bearings and balanced operation insure quietness.

LOW MAINTENANCE—The few wearing parts have hardened steel surfaces. Rolls work only on layer of material, never against metal. Adjustment feature aligns face of roll parallel with grinding ring regardless of wear.

LOW PULVERIZING COST—Due to low friction losses, Bowl Mill consumes less power. Worm gear drive permits use of high speed motor. New grinding principle assures rapid movement of material with resultant higher capacity and lower cost per ton.

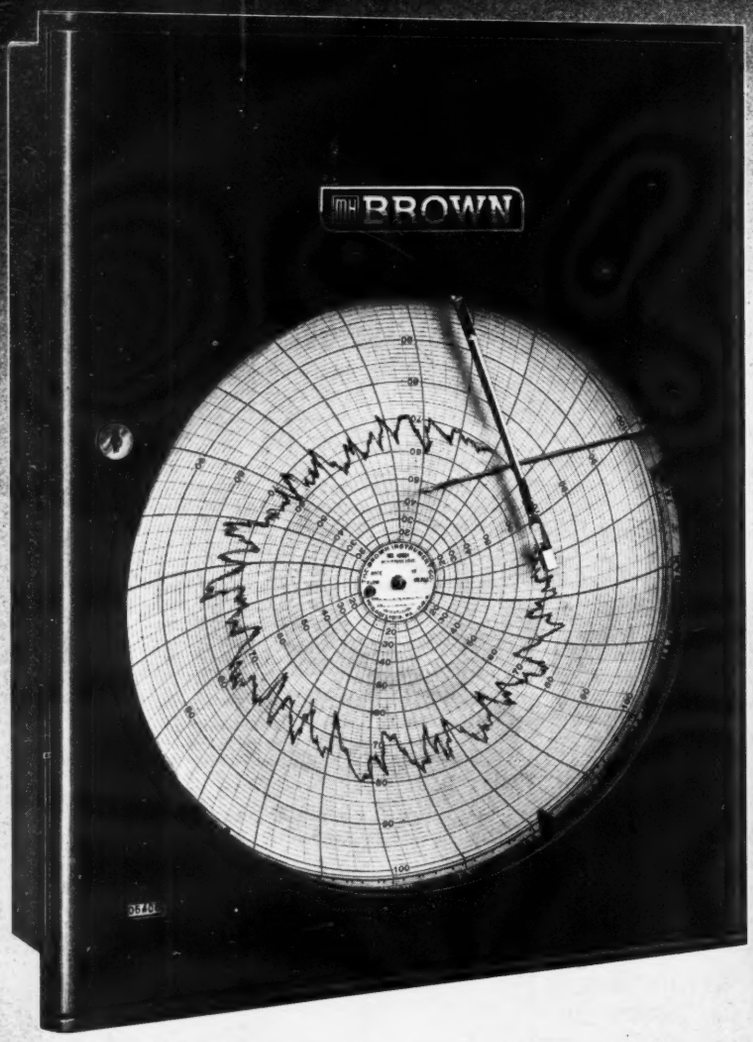
**Based on Pittsburgh No. 8.*

A-488

COMBUSTION ENGINEERING COMPANY, INC., 200 MADISON AVENUE, NEW YORK, N. Y. • CANADA: COMBUSTION ENGINEERING CORPORATION, LTD., MONTREAL

ENGINEERING

BROWN *Announces*



RECORDING, INTEGRATING FLOW METER

Modern
RECTANGULAR CASE

Styled by HENRY DREYFUSS
Designer of the "Twentieth Century Limited"

BROWN ENGINEERS COLLABORATING WITH THIS WELL-KNOWN DESIGNER HAVE PRODUCED AN INSTRUMENT THAT IS NOT ONLY A THING OF BEAUTY, BUT A TRIUMPH OF ACCURACY AND SIMPLICITY.

INDICATING FLOW METER

Advanced Design
ASSURES ACCURATE MEASUREMENT WITH SIMPLICITY FOR METERING FLOW AND LIQUID LEVELS

A NEW LINE OF FLOW METERS

With justifiable pride the Brown Instrument Company presents the latest development in Flow and Liquid Level Recorders, Indicators and Controllers.

These new Flow and Liquid Level Instruments are entirely new inside as well as out. Advanced design of the operating mechanisms provides a new conception of *accurate measurement with simplicity*—the result of years of research and field testing under actual working conditions by Brown Engineers.

The classic, simple lines of the modern streamlined case—styled by Henry Dreyfuss, designer of the "Twentieth Century Limited"—give added beauty and distinction to practical and serviceable instruments.

For modern panel mounting they blend with the panel surface and surrounding instruments to provide the much-wanted flush appearance.

Available with electrical and mechanical meter bodies for the measurement and control of steam, air, oil, gas and other fluids.

Advanced Design Embodies

NEW ELECTRIC FLOW METER: Operates on the Inductance Bridge Principle; inherently independent of voltage fluctuations.

AUTOMATIC PLANIMETER PEN: Gives you a record on total flows over any period of time.

SIX INTERRELATED RANGE TUBES: With corresponding charts and scales make range changing easy, inexpensive.

INTERNAL MECHANISM: All moving parts have been designed to reduce wear and lost motion.

NEW INTEGRATOR: Insures highly accurate totalizing at all rates of flow from 0 to 100%.

DIAL INDICATOR: A 12" dial and new pointer provides better readability.

SIMPLE FLOAT MECHANISM of Mechanical Flow Meter: Insures unhampered float movement and long trouble-free operation. Single lever connects float to pressure-tight bearing shaft. No chains or complicated linkage to impede float movement or get out of order.

LARGE FLOAT: Provides ample power to accurately transmit to the pen minute variations in mercury level, thus assuring accurate measurement.

PRESSURE-TIGHT BEARING—Precision Made: Eliminates the necessity for a stuffing box. The bearing is packed with grease especially suited to the service and operating pressure for which the meter will be used. Automatic, built-in lubricator insures constant lubrication of the bearing under all conditions.

PRESSURE CHAMBERS: Designed to withstand the severe service demanded from this type of meter. High pressure chambers on all meters are forged steel. Sturdiness is built into every part to insure long, trouble-free service.

MODERN RECTANGULAR CASE: Of die-cast aluminum, dust and moisture-proof and resistant to moist salt and acid atmospheres. Includes such desirable features as dust shield, concealed hinges with exceptionally heavy pins, door stop, oil resistant recessed gasket, and cam action handle-lock which draws the gasket firmly against the case.

UNIVERSAL MOUNTING: Universal case permits mounting flush on panel with concealed clamps or on floor stand, wall bracket or pipe saddle.

IMPROVED RECORDING SYSTEM: Linkage is reduced to a minimum. Outboard bearing and hardened pivots on pen shaft insure unhampered pen movement and instant response. Stainless steel pen arm is 8" long, with ribbed reinforcement, permits pen travel of 4¾". Pen and pen arm are non-corroding, easily removed, cleaned and replaced with no effect on calibration. Micrometer adjustment on pen arm assures precision setting.

SIMPLE CHART DRIVE: New chart hub eliminates chart slippage, screw knob and chain—chart is placed on over two tapered studs. Chart hub acts as a time setting device and friction clutch facilitates setting chart for correct time.

RESILIENT MOUNTING: A rigid, flat sub-plate with 3-point, resilient suspension mounting carries all moving parts. Insures permanent alignment.

ELECTRIC AND MECHANICAL METER BODIES: Are available in various models. Each meter body is tested at double its rated working range up to 5000 lbs. pressure.

The above-mentioned features are but a few of the many new developments found in the New Brown Electric and Mechanical Flow Meters

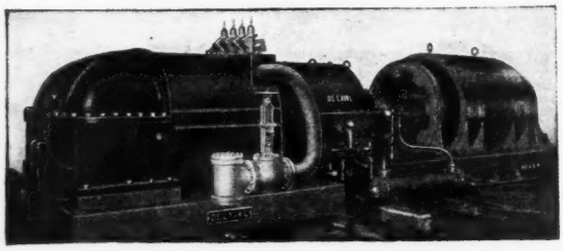
For full details write THE BROWN INSTRUMENT COMPANY, *a division of Minneapolis-Honeywell Regulator Co.*, 4490 Wayne Avenue, Philadelphia, Pa. Offices in all principal cities. Toronto, Canada: 117 Peter Street . . . Amsterdam-C, Holland: Wijdesteeg 4 . . . England: Wadsworth Road, Perivale, Greenford, Middlesex . . . Stockholm, 16, Sweden: Nybrokajen 7.

BROWN Flow Meters

Accurate Measurement with Simplicity

DE LAVAL STEAM TURBINE CO., TRENTON, N. J.

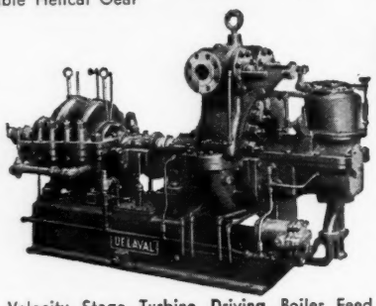
PRODUCTS: Steam Turbines; Centrifugal Pumps; Propeller Pumps; Rotary Displacement Pumps; Mixed-flow Pumps; Submerged suction pump priming systems; Centrifugal Blowers and Compressors; Helical Speed Reducing Gears; Worm Gears; Water Turbines; and Flexible Couplings.



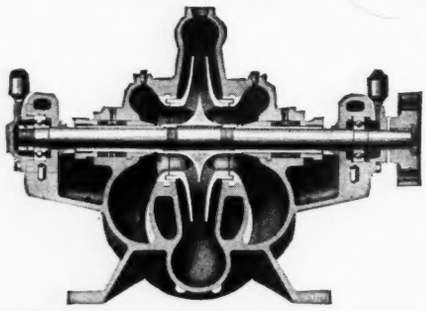
Pressure Stage Turbine Driving 2500 Kw.-D.C. Generator Through Double Helical Gear

STEAM TURBINES:

De Laval turbines are built for modern steam conditions, including high temperature and high pressure, condensing and non-condensing, back pressure, bleeder and mixed flow service. Adapted to driving machines at all speeds, either directly connected or through the DE LAVAL DOUBLE HELICAL SPEED REDUCING GEAR.

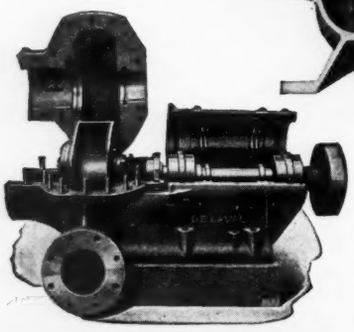


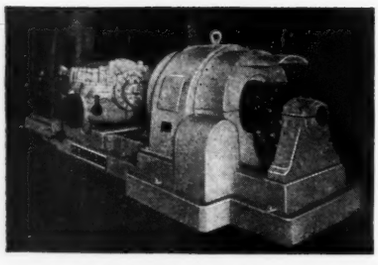
Velocity Stage Turbine Driving Boiler Feed Pump; 285 G.P.M. Against 550 Lb.



Single Stage Pump With Ball Bearings

Clogless Stuff or Sewage Pump





Combination Boiler Feed and Primary Pumps Driven in Tandem by Electric Motor; 1455 G.P.M. Against 1186 Lb. Gage Discharge Pressure

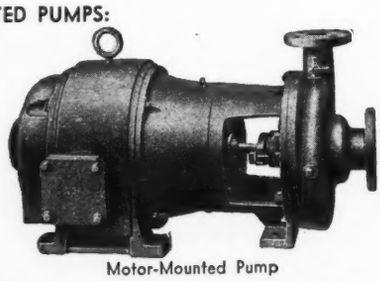
CENTRIFUGAL PUMPS:

De Laval Centrifugal Pumps are characterized by interchangeability of parts and high class materials and construction.

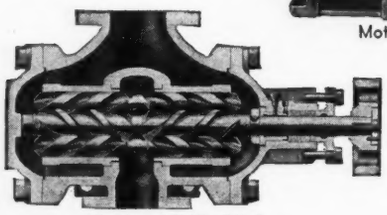
The De Laval Labyrinth Wearing Rings maintain the original efficiency for long periods. Automatic hydraulic balancing system for multistage pumps makes thrust bearing unnecessary.

DE LAVAL MOTOR-MOUNTED PUMPS:

Built in capacities of 5 to 1200 g.p.m. and for heads of 10 to 230 ft. The pump and motor form a compact, rigidly aligned unit with one shaft and two bearings.



Motor-Mounted Pump

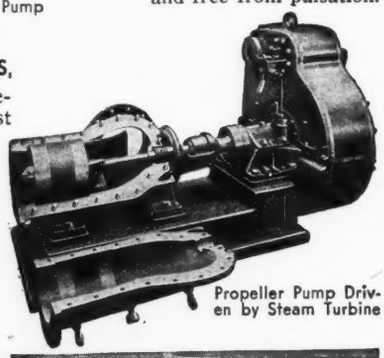


De Laval-IMO Oil Pump

De Laval-IMO Rotary Displacement Oil Pumps, directly connected to standard speed turbines and motors; all pressures up to 500 lb.; highly efficient; quiet and free from pulsation.

DE LAVAL PROPELLER AND MIXED-FLOW PUMPS,

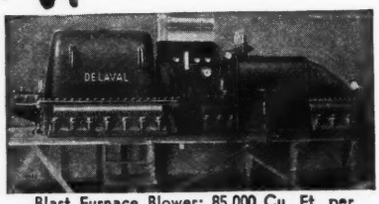
running at high speeds, deliver large volumes against heads up to 40 feet.



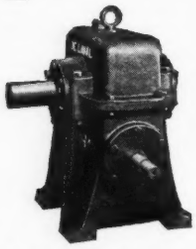
Propeller Pump Driven by Steam Turbine

CENTRIFUGAL BLOWERS AND COMPRESSORS:

Are built single stage and multistage, and for motor or turbine drive, for all pressures up to 100 lb. per sq. in.



Blast Furnace Blower; 85,000 Cu. Ft. per Min. Against 30 Lb.



Bottom Drive Worm Reduction Gear With Anti-friction Bearings

DE LAVAL WORM REDUCTION GEAR:

A superior, modern speed reducer for use with electric motor or steam turbine driving slow or moderate speed machinery. It is efficient, compact, silent, entirely self-enclosed and self-lubricating and immune to moisture and grit.

It differs from ordinary worm gearing in the correct tooth shape, the high class materials used, the heat treatment of the materials and the manufacturing methods and shop control.

The driving worm can be located either at the top or at the bottom, and with the driven machine either at the right or the left. Vertical shaft drives are also supplied, with the shaft extending above or below. Single reductions are built for ratios up to 100 to 1, while double reductions provide for ratios up to 8000 to 1.

GUARANTEES:

All De Laval apparatus is built on a limit gage, interchangeable basis and finished repair parts are supplied, made to accurate dimensions. Every machine is guaranteed, both as to capacity and efficiency, and is tested at our works.

SALES OFFICES

ATLANTA
BOSTON
CHARLOTTE
CHICAGO
CLEVELAND
DENVER
DETROIT
DULUTH
HELENA, MONT.
HAVANA
HOUSTON
KANSAS CITY
LOS ANGELES
MANILA, P. I.
NEW ORLEANS
NEW YORK
PHILADELPHIA
PITTSBURGH
ROCHESTER, N. Y.
ST. PAUL
SALT LAKE CITY
SAN FRANCISCO
SEATTLE
TULSA
WASHINGTON, D. C.
EDMONTON
MONTREAL
TORONTO
VANCOUVER
WINNIPEG
SAN JUAN, P. R.

843